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Advertisement Index, see page xxxii.

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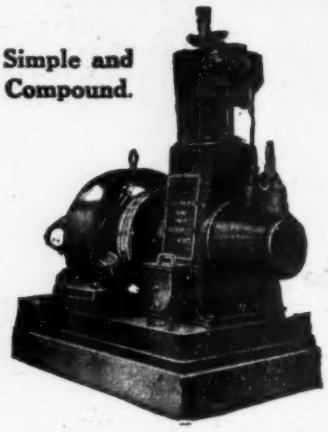

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Vol. LXXXVI.] CONTENTS: January 9, 1920. [No. 2,198.

	Page
The Future of Electricity Supply	33
Relativity	34
The Need for Engineering Goodwill	34
Fools and their Money—	35
Making Both Ends Meet	35
Electricity in Mines	35
Electric Heating	35
The Electrification of the Melbourne Suburban Railways (*illus.*)	36
Electric Ignition : Coil and Magneto Systems, by F. H. Hutton	40
Electrical Trade of India	42
Correspondence—	
The New Cable Standards	43
The "Lesco" Holder	43
The Fuel of the Future	43
Reviews	43
Business Notes	44
Notes	51
City Notes	55
Stocks and Shares	56
An Electrically-Heated Theatre (*illus.*)	57
Scientific Management : A Solution of the Capital and Labour Problem	58
New Electrical Devices, Fittings and Plant (*illus.*)	60
Trade Statistics of Canada	61
Electricity in Tin Mining, by D. M. W. Hutchison and W. J. Wayte (*illus.*)	62
New Patents Applied for, 1919	64
Abstracts of Published Specifications	64
Contractors' Column ... ... Advertisement page xxiv	

THE PRICE OF THE "ELECTRICAL REVIEW."

During the War, almost exceptionally among technical publications and periodicals of the character of the ELECTRICAL REVIEW, we have refrained from increasing the price. Owing, however, to the constant increases in cost of paper, printing, engraving and production charges generally, we have reluctantly decided that the price from the beginning of this year must be raised to 6d. per copy. The change will not apply to unexpired subscriptions.

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THE FUTURE OF ELECTRICITY SUPPLY.

Now that the Electricity Supply Bill has become an Act, it is to be hoped that we shall soon see tangible results. In a number of undertakings extensions of the generating plant are urgently needed, but the whole matter has been hung up pending a settlement of the national policy embodied in the Bill. Now at last there is a chance of making progress. Moreover, at present the matter is, to a great extent, in the hands of the undertakers themselves. We say at present, since a further Bill (to provide for the establishment of district boards and compulsory expropriation) is threatened (or promised, according to one's point of view) for next session. But in the meantime undertakings have a free hand to form joint electricity authorities by voluntary action, subject to the approval of the Electricity Commissioners—when they are appointed. The chances of the supplementary Bill being passed appear, to a great degree, to be contingent on what has been done to form joint authorities up to the time when the Bill is brought forward. If joint authorities are actually in existence in all the principal districts when the new Bill is put before Parliament, the Bill will obviously have little justification. But if the undertakings are backward in taking action, or if mutual jealousies or animosities are allowed to delay the formation of joint authorities, the most powerful arguments will be put in the hands of the supporters of the Bill.

As a matter of fact, a good deal of spade-work has already been accomplished in this direction. South Lancashire, which has been in the van of progress ever since the subject was broached, as the valuable reports which we have published bear witness, was on the verge of forming a joint authority in 1917, but the scheme broke down owing to the refusal of the local authorities to consider the purchase of existing stations and the erection of new ones, and progress was confined to the linking-up of a number of power stations. However, the scheme was so far developed that there should be no difficulty in picking up the threads, and this time, we imagine, the municipal authorities will approach the subject in a very different frame of mind; it would be something of an anti-climax if they, of all people, should prove to be the stumbling-blocks!

Again, considerable progress has been made in other areas, such as the West of Scotland, South Wales and Monmouthshire, Dublin and district, and elsewhere with linking-up proposals, which should be of great assistance in connection with the more comprehensive projects now called for, and movements have been set on foot in the Midlands, at Dundee, Stalybridge, Bradford, Sheffield, and other centres towards the formation of joint authorities. The latest development comes from the West of England, where, for Gloucestershire and the surrounding counties, a joint electricity authority has already been provisionally arranged. Due largely, we surmise, to the "push" of Mr. Faraday Proctor, representatives of the undertakers in the area, and certain local authorities that were interested, were brought together last Friday in Bristol Town Hall, with the result that a joint authority was agreed upon, and resolutions were passed, which, if confirmed by the companies, councils, and others there represented will settle the preliminaries at least as far as the principle is concerned, a by no means mean achievement at one meeting, and within a fortnight after the Bill became law. If succeeding steps are taken at the same rate, we ought soon to see

the first joint electricity authority in being. We hope, however, that this will not be an isolated phenomenon, but that in speed the Gloucestershire area will be only *primus inter pares*.

Small undertakings all over the country await, with considerable impatience, the setting-up of joint authorities, trusting that these may provide some way out from their difficulties in providing additional generating plant. Big undertakings are also holding their hands. It is to the interest of everyone, therefore, that the Act shall be put into operation immediately for all it is worth. When shall we have the names of Sir John Snell's four colleagues?

Relativity.

IT is generally assumed, or taken for granted, that the special province of philosophical physicists is to *explain* the order of physical occurrences, which means to express it in terms of common-sense. Judging by what has transpired between them during the last two months, their efforts in this direction have been meeting with less than a moderate measure of success. There has always been some difficulty in explaining action at a distance, since it prompts the question: How can a body act where it is not? In the case of light, after the corpuscular theory had proved inadequate, the luminiferous ether was introduced to explain it. In the case of gravitation, we were settling down simply to accept action at a distance as a fact; indeed, most people were content to leave it at that; but this did not satisfy Dr. Einstein, who, armed with a new mathematics of transcendental power, set out to show it was a property of space. The spectacular success he achieved in predicting the deflection of light from the stars by the gravitational field (we must no longer say the attraction) of the sun, will be in the minds of all our readers; but, although we cannot withhold our admiration of the result achieved, it does not prove that the mathematical conceptions he formed in reaching it have actual counterpart in reality. His general line of reasoning is set out very fairly in the contribution he made to *The Times* of November 28th.

He points out that the mechanical laws as enunciated by Galileo and Newton hold good, not only for a system of co-ordinates at rest, but for every other system of co-ordinates that moves in respect to it with uniform rectilinear motion. He then inquires why the validity of these laws should be confined in this arbitrary way. Why should not these laws hold good, though the system of reference be subject to acceleration, and, or, rotation? Such a development would, of course, introduce forces indistinguishable, by any means known to us, from forces of gravity; for a gravitational field of force is exactly equivalent to a field of force introduced by a transformation of the co-ordinates of reference, so that by no possible experiment can we distinguish between them. The objection which at once occurs to everyone is: if what I am accustomed to think of as my weight is due to a perpetual acceleration of my body away from the centre of the earth, how is it that I remain always at the same distance from it?

The surmounting of this difficulty is the essence of his theory, and if, so far, all the great men of science have excused themselves from the task of making clear how that is done, it is unlikely that we shall succeed in doing so. Suppose, however, you are in flat land. Since there is no third dimension of height or depth, we shall not know gravity as on this earth. Now, suppose flat land to undergo rotation about a horizontal axis situated behind you. Then all things, including yourself, would be subject to a force of the kind called centrifugal, but indistinguishable from gravity acting throughout flat land. You would tend always to slide forward, and would exercise pressure on all that restrained you. To apply this analogy to things as they are, you must invoke what is called non-homaloidal space-time, which is a curved surface in five dimensions. This, of course, is absolutely inconceivable, indeed, it is of the order of inconceivability squared, and if Dr. Einstein esteems it his business to explain gravitation, he has singularly failed, for an explanation that revolts common-sense is not an explanation at all. The fact remains, however, that he has achieved correct results in at least two problems which have proved irreducible by any other means.

That the instruments of his reasoning have therefore objective reality is a conclusion it would be unwise to draw, for do we not frequently arrive at correct results by the agency of instruments that are inconceivable, in the sense of being meaningless as his are? Suppose we are given the area of the face of a cube and invited to find its contents. The area is, let us say, 100 sq. in. We had best proceed by taking the square root of this, which will give us 10 in., a quantity we can realise and verify with a foot-rule if we like. Then cubing this we have 1,000 cu. in. for the contents required. But we may proceed in another way. We may begin by cubing the 100 sq. in., which will give us 1,000,000—but a million what? Nothing on earth, or elsewhere. These are, indeed, units which we cannot imagine or conceive, much less verify physically with a foot-rule. Nevertheless, taking the square root of this number, we get 1,000 just as before for the contents required in cu. in. Now this result does not prove the existence of space in six dimensions. In the same way the correctness of Dr. Einstein's calculations does not guarantee the objective reality of any conceptions he may have framed for the purpose of carrying them out. Moreover, these same conceptions, being of the purely mathematical kind, may be capable of entirely different interpretations. Sir Joseph Larmor made a communication to a meeting of the Royal Society, held on November 20th, which proposed a re-arrangement of essential features in Dr. Einstein's theory, whereby it becomes a theory of correspondence between different modes of specifying the activity of physical systems, and not directly a theory of relativity at all.

The Need for Engineering Goodwill.

THE note of optimism which we adopted last week in our brief forecast of the electrical industry is also struck by Sir John McLaren, chairman of the Leeds Engineering Employers' Federation, in a New Year message regarding the whole of the engineering industries. There are boundless opportunities for engineering, and, therefore, for engineers, and Sir John is probably perfectly correct when he promises unlimited employment and good wages for all who care to work. As we have passed out of Peace celebration year, we may with some measure of confidence hope that there will be a greater disposition to work—to do good work—and to increase production. But all our optimism and confidence are necessarily moderated, because we know well enough that there will not be prosperity for all, even when the demand for manufactures is so overwhelming, unless there is peace. Most appropriately, and seasonably, Sir John calls for goodwill—goodwill among both workers and employers. If we have that we shall prevent "paltry grievances" on the part of a handful of men holding up large sections of industry, and we shall also be able to secure such a large output that, while the demand is so great, the present wages will be justified. Whether or not, or for how long, wages will remain at their present level, must depend partly upon the cost of living and partly upon whether we are able to secure a strong position in the export field. High production and efficient methods should enable us to reduce costs, so that our overseas customers will find it possible to continue to purchase from us rather than from somebody else. Everybody ought to be brought to see—some are learning the lesson painfully—that mere high wages are not necessarily a sign of industrial prosperity, nor with the cost of living high are they a sign that the employé is any better off than he used to be. It is only in the atmosphere of a genuine goodwill that such aspects of our industrial problems can be calmly and sanely considered. If hot-heads and extremists are in the saddle, we can hardly expect goodwill. They may find it congenial to flare up at the mere mention of lower wages ever becoming necessary in the engineering trades. But Sir John, in a New Year plea for goodwill and industrial peace, is not living in so unreal a world that he can be induced to forget the possibility that such a necessity may

arise sooner or later. He was speaking as an engineering employer, and presumably, therefore, his allusion to the possible necessity of wages coming down "in some trades, or even all round," was intended to relate to even the, at present, very active engineering industry. He repudiates any suggestion that he is an advocate of low wages, but foreshadows that a reduction may become a pure economic necessity "so as to bring the cost of manufacturing to a figure which will enable foreign customers to purchase from us." We may be permitted to hope that by such a time the cost of living will have reversed its present course, also that by means of scientific production and earnest effort, we shall have found it possible to decrease costs of manufacturing without decreasing wages. We hope that the belief that the extremist is growing in disfavour, will be justified by the course of events in the engineering and electrical trades. It rests with the large body of serious-minded men in these activities persistently to bring the weight of their influence to bear in conversation with their comrades, so as to ensure that British chances of successful employment shall not be jeopardised by reckless policy, or even be rendered unstable by inflammatory talk. It equally rests with all employers, whether big concerns with many millions of capital or small firms with a few "hands," to act generously toward and to study reasonably, without objectionable coddling, the well-being of those who, in earning their livelihood, are securing the return upon capital. It is only by all parties working together in harmony that we can secure the maximum benefit for all.

Fools and Their Money—

THE wild-cat scheme to which we referred last week, for the generation of electric power by converting the public roads into treadmills, is being put forward as a bait to catch the unwary investor; one-third of the world rights of the "patent" (save the mark) is being offered by advertisement for £20,000. To explain that, even if such a scheme were practicable, the energy would be supplied by the owners of the vehicles that traversed the roadways, who would not tolerate any such robbery, would be to insult the intelligence of our engineering readers; it is conceivable, however, that some person with more money than wits might be induced by the foolish editorial notices in the lay Press to part with the former, and in the hope of saving possible victims from disaster, we invite our readers to help us in disseminating a warning as to the futility of the proposal.

Making Both Ends Meet.

THE new and unforeseen conditions with which electricity supply undertakings are faced, will demand certain revisions of the terms under which they have hitherto been working. Some method must be devised so that supply undertakings may make both ends meet. In many undertakings the continuously-increasing working expenses are bringing them perilously near having to shut up shop. The seriousness of the situation is very well illustrated by a Bill which is now being promoted by a group of companies, the title of which is "Edmundson's Electricity Corporation, Limited, and other Electric Supply Companies (Increase of Charges) Bill." Particulars of the Bill are given elsewhere in this issue. As explained in the preamble, the capital of the undertakings included exceeds £1,300,000, and we see by the schedule that 30 Provisional Orders are covered.

The undertakings represented by these Orders are situated in widely different districts, so that the conditions which the promoters are trying to remedy may be taken as normal to most small-sized undertakings throughout the country.

The preamble to the Bill voices a crying necessity. It claims that owing to the great cost under existing conditions of carrying on the undertakings scheduled in the Bill, the revenue obtainable within the limits of the statutory maximum prices is in certain cases insufficient to meet the working expenses after making provision for depreciation, and in the remaining cases is barely sufficient for that purpose. Continuing, it explains that the remedy proposed in the Bill is necessary to enable the companies to fulfil their statutory obligations and to carry on efficiently, and to render possible the raising of further capital to meet the increasing requirements of consumers. This preamble would, of course, fit many more undertakings than those scheduled in the Bill. As to the remedy suggested, it is proposed that the maximum price should be raised to 1s. 2d. per unit (the highest maximum price, we believe, yet applied for), qualified by a kind of sliding scale adjustment of the actual price to be charged. If the company charges 1s. per unit, or over, the company shall only retain of the revenue a sum not greater than would pay 6 per cent. on the capital employed. If it charges less than 1s. per unit, the company shall retain, in addition, a sum equal to half of 1 per cent. on the capital employed for each halfpenny by which the charge is less than 1s. Whether this particular method is one which will find favour in the House, or with the Electricity Commissioners, is an open question. But that some such kind of wide revision of the present rigid system of maximum prices is, in many cases, absolutely necessary, is beyond doubt. The Bill, therefore, touches upon a matter of crucial importance to a very wide section of the electricity supply industry.

Electricity in Mines.

NEW YEAR'S DAY often has, in addition to its ordinary significance, a special connotation in relation to particular persons and things; and the first day of the year which is already growing old was noteworthy for its special meaning to colliery engineers—for the regulations for the use of electricity in mines which were put in force on July 10th, 1913, were not to apply to apparatus installed before June 1st, 1911, until January 1st, 1920. *Eheu fugaces labuntur anni!*—that date has come and gone; but who could have foreseen the world-shaking events which have intervened? or the utter impossibility, in those times of toil and stress, of carrying out the alterations necessary to comply with the Rule? Application is to be made to the Home Office to extend the time for a further period of two years, a proposal which certainly cannot be regarded as unreasonable: and as the Home Secretary has power to grant exemption in cases which he considers worthy of it, there should be no difficulty in complying with the request—more especially in view of the fact that the mines are under State control, in name at least (some say they are controlled by the miners, in fact). To what extent the electrical equipment of the coal mines has already been brought into conformity with the Rules, we have no information.

Electric Heating.

MUCH has been heard of late regarding the relative merits of gas and electricity for heating purposes. As we have often pointed out, the only sound criterion is the practical test, and we have pleasure in drawing attention to the description of the new heating system of the Lyric Theatre, Hammersmith, which appears elsewhere in this issue. Actual trial there shows that the cost of installation of electric heating apparatus throughout the theatre was only one-third of that of a hot-water system, and the running cost is only half that of the gas-heating system which has been displaced on account of its inefficiency, although the electrical energy is not supplied at a specially low price. Moreover, the results obtained from the electrical installation have been most satisfactory. The heating of a theatre is a difficult problem, and it is gratifying to know that, as usual, the electrical method provides an adequate solution. The facts that the whole of the electrical system is controlled from a central point, and requires no personal attendance, whereas the gas radiators had to be visited when starting and stopping, and that fire risk is reduced to a minimum, are other strong points in favour of electricity, which, moreover, can be installed with practically no disturbance to the decorations or inconvenience to the patrons of the theatre.

THE ELECTRIFICATION OF THE MELBOURNE SUBURBAN RAILWAYS.

THE railway system of the State of Victoria, Australia, is operated by the State Government, the executive functions being exercised by three Railway Commissioners; at present there are only two, Mr. C. E. Norman, chairman, and Mr. W. M. Shannon. The electrification scheme owes much of its success to the late Mr. E. B. Jones, for some years a Commissioner, whose death before the completion of the work was a serious loss to the Victorian railways.

The total track mileage of the railways is some 4,300, of which over 300 miles are suburban lines serving the city of Melbourne. The importance of the Melbourne suburban traffic to the whole system is shown by the fact that it accounts for some two-fifths of the total train-mileage of the railways entering Melbourne. Not only are the suburban railways of greater importance to the system as a whole than in other countries, but they are of greater importance to the city itself than are the suburban systems of most other cities. Owing largely to the foresight of the authorities responsible for laying out the city, the density of population is only about one-fifth of that commonly found in this country. The result is that the suburban railways cover an unusually large area, in spite of there being an excellent cable tramway, and deal with a large amount of traffic which in other cities is catered for by electric tramways, interurban railways, or motor omnibuses.

The conversion of the Melbourne suburban lines to electric traction was first considered in 1907, when, at the request of the Hon. Sir Thomas Tait, K.C.M.G., chairman of the Commissioners, Mr. Charles H. Merz, of London, visited Melbourne and presented an exhaustive report (June, 1908) on the whole question, which showed that although there would be a considerable saving in operating expenses, an increase of traffic would be necessary to cover the capital charges. An increase in traffic more than sufficient for this purpose was anticipated, but it was decided not to proceed with the electrification at that time. By 1912, however, the traffic had increased very much more than had been estimated, and sufficiently to necessitate either expensive track widenings, or alternatively to justify the capital expenditure involved in electrification, even if this produced no additional traffic. At the request of the Hon. W. A. Watt, then Premier of the State of Victoria, a

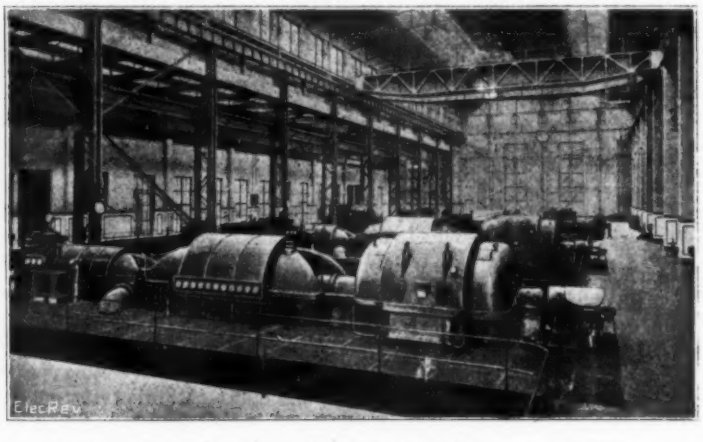

FIG. 1.—TURBINE ROOM AT NEWPORT POWER STATION, AUSTRALIA.

further report was presented by Messrs. Merz & McLellan, based upon actual tenders from manufacturers. Alternative prices were obtained for the single-phase and direct-current systems. The latter proved to be substantially cheaper both in capital expenditure and operation. Contracts were, therefore, placed providing for the conversion of the whole of the suburban lines on the high-pressure, direct-current system, the work to be carried out in three stages. With the exception of the coach equipments, all the contracts have been executed by British or Australian firms with the stipulation that manufacture of the British contracts was to be carried out in this country. The coach equipments were ordered in America with the special condition that some of the motors were to be made in England.

The scheme is one of the largest and most important railway electrification works as yet carried out. The leading engineering features are the production of electrical energy at 3,300 volts between phases, by means of three-phase, 25-cycle, turbine-driven alternators, raised to 20,000 volts by static transformers, its transmission to sub-stations where it is converted to 1,500-volt direct current, and its supply at this pressure to the trains by means of an over-

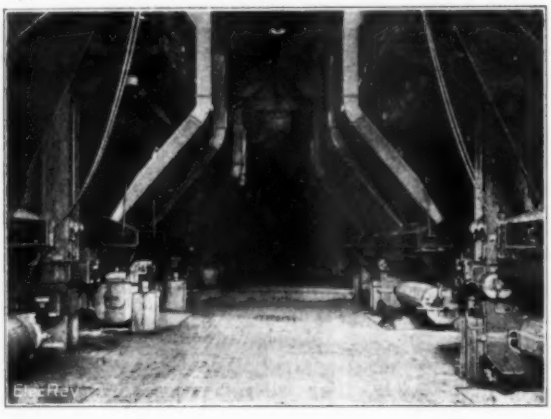

FIG. 2.—NO. 1 BOILER HOUSE—FIRING FLOOR.

head contact wire. The main contracts were placed in March, 1912, work was started in November, 1913, and the first train was run on May 29th, 1919. The work has, of course, been much delayed by the war.

Power Station.—The power station was originally to have been placed on the River Yarra at Yarraville, the nearest available site to Melbourne having a good supply of condensing water and reasonable access by rail. It was, however, decided to adopt a site at Newport which had certain advantages in connection with condensing water, sub-soil, &c., that compensated for the additional expenditure on transmission cables. Thus the existence of a stone breakwater enabled the intake and discharge to be separated in a manner which is not ordinarily obtainable without considerable expense. The site consists of some 36 acres of land adjoining the Williamstown Ferry, and is mostly situated on basaltic rock which, while providing a satisfactory foundation, involved considerable extra work, some 45,000 cb. yards having to be removed. The site has been laid out to contain two power stations side by side, the position of the future station being indicated by broken lines in fig. 5. In this way full advantage may be taken of any future developments in power-station design without interfering with the symmetry of the present station. The first station is laid out to contain six 10,000-KW. turbo-alternators, which suffice for present requirements, and include two spare sets for the purposes of stand-by and over-haul. The two boiler houses are at right angles to the engine room, and each is provided with its own coal store and coal-handling machinery. The elevation of the power station is shown in fig. 6. Between the two boiler houses is a space occupied by a general-purpose building containing stores, water-storage tanks, workmen's accommodation, laboratories, test tanks, &c. Placing these accessories in this position has proved efficient as regards administration

and working, and the separation of the engine room from the boiler house by a lower pump room has a good effect.

Boiler Houses.—The equipment of each of the boiler houses, fig. 2, is as follows :—12 Babcock & Wilcox marine type water-tube boilers, 30,000 lb. normal evaporation, 210 lb. per sq. in. working pressure, 610° F. total temperature of steam, 6,725 sq. ft. heating surface, 168 sq. ft. grate area ; two chain-grate stokers per boiler ; 288-pipe Green economiser per boiler ; six Sirocco fans, one fan to two boilers ; two Weir impulse turbine-driven centrifugal feed pumps ; two Nichols vertical single-cylinder feed pumps, 30,000 lb. capacity water per hour, each type feed pump ; two sets ash-handling plant ; three coal conveyors, 40 tons per hour each ; one coal storage yard and crane.

The boilers are arranged six a side in pairs, each boiler having its own integral superheater and economiser. One steel chimney, 7 ft. in diameter and 58 ft. above economiser floor level, with an induced-draught fan, serves each pair of boilers. The furnaces are arranged at present to burn coal from the State mine at Wonthaggi or Newcastle (N.S.W.), but the arches could, doubtless, readily be adapted to burn brown coal if necessary.

Coal and Ash-Handling Plant.—The storage and handling of coal is provided for by means of railway sidings, the full and empty wagons being worked in a continuously forward direction. The 15-ton hopper wagons dump their coal into large hoppers below the track, between the boiler houses and the storage yard. From these hoppers the coal passes to the bucket conveyors below, which carry it over weigh-bridges, weighing four buckets at a time, to the coal bunkers above the boilers, or by the central conveyor to the coal storage yard. Motor-driven crushers are provided below the hoppers. The coal, on reaching the gantry over the coal storage yard, can be automatically dumped where required, just as in the coal bunkers. In addition, a grab, handled by an electric jib-crane of the luffing type, can be used to spread the coal over the storage area. To recover this coal for the boiler houses, the grab can be brought into use again, feeding the chutes to the travelling coal filler in the underground passage below the storage ground, which returns it to the other conveyors ; or the grab can deliver it direct into an auxiliary hopper on the end of the coal gantry, which, in turn, feeds the main hopper.

The ash-handling equipment consists of two sets of suction plant, each with an exhauster driven by a 60-B.H.P.

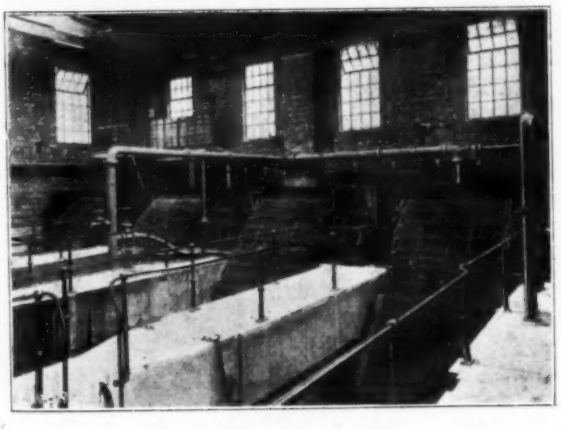

FIG. 3.—SCREENING PLANT.

motor, and a receiver, into which the ashes are drawn while being subjected to a fine spray of cooling water. The four ash bunkers are erected over the track on which ash wagons are worked in between the coal wagons. A few ½-ton trucks, running on narrow-gauge rails under the furnaces, are provided for ash handling in case of emergency. The suction ash plant also deals with the soot from the economisers.

Generating Plant.—The generating plant is so arranged that, provided any one boiler is in steam, any one turbo-alternator can be started up ; but, as no atmospheric exhaust valve is fitted between the condenser and the turbines, these are not intended to run on atmosphere, and two small auxiliary turbines, each of 350-K.V.A. capacity, have been installed for starting up the power-house auxiliaries at any time when all the main turbines have been shut down. In addition, the breakdown of anything comprised in one generating set will not prevent the operation of the remaining sets.

Each prime mover is treated, as far as possible, as an independent unit ; thus each turbo-generator has its own oil-cooled transformer for stepping up to 20,000 volts, and a transformer stepping down to 440 volts for operating the circulating water, oil-cooler, and air-filter pumps, &c.

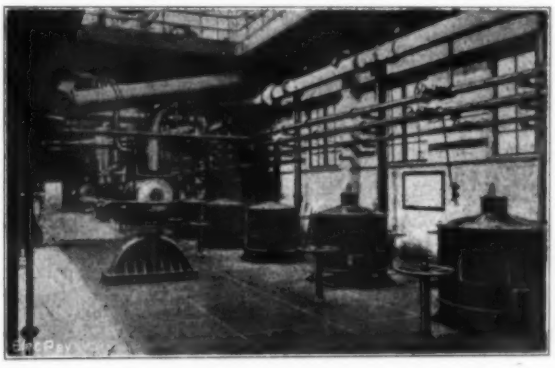

FIG. 4.—PUMP HOUSE : CIRCULATING PUMP MOTORS IN FOREGROUND.

Although experience seems to indicate that oil in transformers presents a negligible fire risk, it was thought wise to install the transformers belonging to each generator in a chamber outside the engine room ; this being out of reach of the engine-room crane, special provision is made for lifting the transformers off railway trucks. Between the transformer chambers are intervening chambers containing air-filters, neutral resistances, &c. The whole of the condenser, boiler feed, transformer, air cooler, turbine oil cooler, and air-filter auxiliaries are placed on the same level in the basement, and easily accessible, the basement being well lit and free from obstructions.

The turbine room, fig. 1, will ultimately contain six Parsons horizontal pure-reaction turbines, with divided cylinders, 1 h.p. and 2 (or one double-flow) l.p. cylinders. The normal working conditions are : Steam pressure, 200 lb. per sq. in. ; steam temperature, 600° F. ; vacuum, equal to an absolute pressure of 1·25 in. mercury ; speed, 1,500 R.P.M. Energy is generated at 3,300 volts, 25 cycles, three-phase, the economical output being for four sets 10,000-KW. each and for two sets 12,500-KW., at 0·95 lagging P.F. The maximum continuous capacity is four 12,500-KW. and two 14,000-KW., while the maximum output for short intervals is four 14,000-KW. and two 15,000-KW.

In addition, there are also provided six Weymouth twin-surface condensers of the "Contraflo" type, each twin condenser having a cooling surface of 22,000 sq. ft., and being capable of dealing with 120,000 lb. of steam at a vacuum of 28·8 in. when supplied with 14,000 gallons of circulating water per minute at a temperature of 60° F. ; six Michell-type Weymouth air-and-water-extraction pumps, working on the kinetic system, each combined set of air-and-water-extraction pumps being driven at a speed of 750 R.P.M. by an induction motor of 80 E.H.P. ; six circulating-water pumps, each of the vertical-turbine type, and capable of delivering 40,000 gallons of water per minute when driven at a speed of 500 R.P.M. by a vertical induction motor of 225 E.H.P. ; six bilge pumps of the vertical centrifugal type, capable of lifting 100 gallons of water per minute against a head of 35 ft. when driven by induction motors of the liberal rating of 6 E.H.P. at 750 R.P.M.

The are six Sirocco ventilating fans, each driven by a 30-B.H.P. Westinghouse induction motor ; six transformer oil circulating and wet-air filter pumps, each being driven by a Westinghouse induction motor of 15 B.H.P. ; six 350-K.V.A. auxiliary turbo-generators, non-condensing, generating three-phase energy at 440 volts, 25 cycles, for

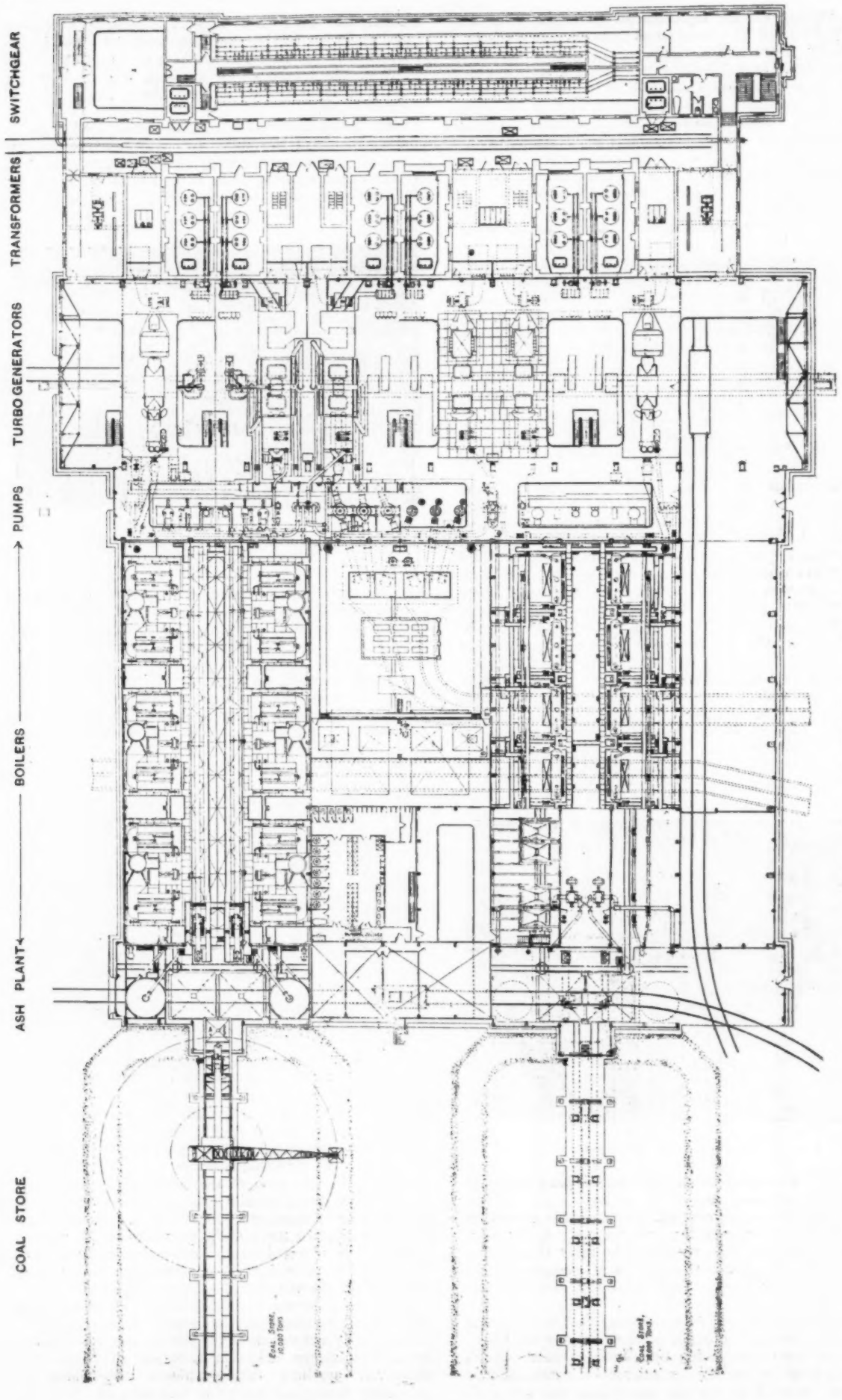

FIG. 5.—PLAN OF POWER STATION AT NEWPORT, AUSTRALIA.

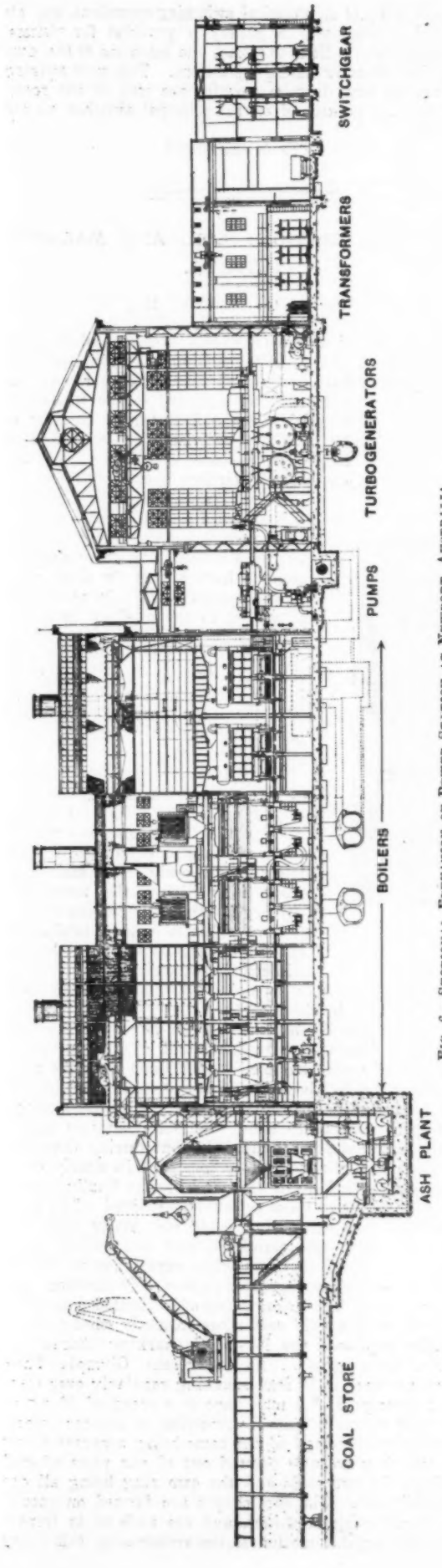

Fig. 6.—Sectional Elevation of Power Station at Newport, Australia.

starting up; sundry motor-driven oil pumps, an air compressor and a vacuum cleaner. The Babcock & Wilcox turbine room crane has a capacity of 60 tons, with an auxiliary hoist capable of lifting 50 tons, the span being 75 ft. Fifteen-ton hand-operated cranes, by the same firm, are provided for the repair shop and pump house.

The high and low-pressure portions of the turbines are in separate cylinders, the high-pressure cylinder being of cast steel. The rotor shafts and disks are forged of solid steel. Each turbine is directly connected to the condenser below it, which is supported on large steel spiral springs. There is no exhaust valve between the turbine and the condenser, it being intended that these turbines shall not run on the atmosphere longer than is necessary to get a spare turbine into commission. In the case of the two turbo-alternators yet to be installed, the economical output of the turbine has been raised to 12,500 KW., and the maximum continuous output to 14,000 KW., the steam consumption being correspondingly reduced. The machines will be similar to the four already installed, the improved rating being obtained by "end-tightening" of the blading, and other modern improvements. The speed of the turbine can be controlled by a small electric motor from the control room switchboard. Oil is supplied continuously under pressure to the bearings by means of two gear pumps, a steam-driven pump being provided for starting up and shutting down.

The alternators are totally enclosed and ventilated by fans on the rotors, in addition to the forced ventilation by means of the separately driven Sirocco fans. The alternator is excited by an exciter mounted on an extension of the alternator shaft, the exciter being of the compound type, but without commutating poles. The construction of the stator windings of the alternator is interesting. Cotton-covered stranded wires are laid up into an oval conductor the full area of the slot; each conductor is soldered to a flat copper end-connection, thus simplifying the end connections, and facilitating rigid anchoring. The Michell type thrust bearing, an Australian invention, is used throughout.

Water Supply.—The situation of the circulating pumps is a novel and convenient feature of the design. The water supply to the pumps is in duplicate, with arrangements so that four pumps may be supplied from each half of the duplicate system. As this is sufficient for the full-load output of the station, overhaul operations in connection with the maintenance and upkeep of the water-supply system can be carried out at any time as a matter of routine. Condensing water is taken from the River Yarra, to which it is returned on the opposite side of the retaining wall after use. The two collecting channels terminate in screen pits, the water passing first through stationary screens, which remove only the heavy *débris*, and then through revolving screens consisting of link chains carrying galvanised iron-wire screens. Four screens are provided (fig. 3), each being driven by a Westinghouse 5-B.H.P. motor. The screens are washed by jets of water supplied at 50 to 60 lb. per sq. in. pressure by two pumps driven by Westinghouse 53-B.H.P. motors. The screens were supplied by Messrs. Babcock & Wilcox, and the pumps by Messrs. Gwynne, of London. The pumps are installed in a pit below the pump-house basement, so that they are flooded at all stages of tide. The induction motors (fig. 4) driving these pumps, which are mounted on the turbine floor level, are of the vertical type, equipped with Michell thrust bearings; separate thrusts are provided for the motor as distinct from those for the pump shaft, the drive being through a flexible coupling.

Power Station Switch House.—One of the most interesting features of the installation is the switch house. This is parallel to the engine room, but at some slight distance from it, there being no attempt to provide ready communication between the switch-house and the engine-room staff except by telephone and telegraph. All main switching is carried out at 20,000 volts. The power-station bus-bars are divided into two sections by means of a section switch, each sub-station being fed from both sections. So far as security of supply is concerned, therefore, the arrangement may be regarded as equivalent to duplicate bus-bars without the complication and expense of

the latter. Another feature is the arrangement for preventing accidents, a system of mechanical interlocking being provided which prevents all possibility of an operator obtaining access to conductors while they are alive. This applies not only to the conductors of each switch panel, but to the sections of the bus-bars themselves; that is to say, access to each section of the bus-bars is entirely prevented until the whole of the isolating switches connected to it are open, thus ensuring that the bus-bars are dead. In addition, each oil switch is interlocked with its isolating switches, so that the latter cannot be opened or closed while the oil switch is closed. The oil switches are electrically operated with remote control, the operating mechanism having a wall separating it from the oil-switch chamber, so that it can be examined and cleaned without danger.

An interesting feature is the absence of windows in the switch house. One side of each switch cell is open to the outside air, in order immediately to release any excessive air pressure in the event of an unusually heavy short-circuit. Precautions are, of course, taken to prevent the entrance of birds, rain, &c.

Each phase of the main switches is a separate single-pole switch in its own oil tank, the parts working in air being isolated from the parts working in oil. Each S.P. switch has multiple breaks in series, arranged vertically close together in the middle of the tank, with insulating barriers between adjacent breaks, there being four breaks in the S.P. generator oil switches. These are so connected that upon the switch opening under load the mutual induction of the arcs produces a radial blow-out effect towards the insulated wall of the tank. Opening speeds up to an equivalent of 50 ft. per second can be obtained, aluminium being employed to ensure rapid acceleration. The gases produced are discharged to the outer passage way.

FIG. 7.—CONTROL ROOM.

The three-phase oil switch will safely open a short circuit on a system controlling power of a rated capacity of 240,000 K.V.A. The operating gear consists of a rotary type magnet actuating a countershaft through a toggle mechanism and tripping box, the magnet being excited from a 110-volt battery supply and contactor, operated from the control board. In addition to red and green indicating lamps, there is an alarm-bell device to give warning when the switch has opened.

The generator equipments are fitted with Merz-Price protective gear, while feeder equipments have split-conductor protective gear. Each generator has an emergency control pillar and load indicator fixed in the engine room.

Control Room.—This is situated at the end of the switch house (fig. 7). In it is centred not only the control of the main power-station switches of the generators and transmission feeders, but all electrical operations throughout the entire transmission and conversion system are directed from this point. On the control engineer rests the responsibility of all electrical switching operations, and his control is absolute. A gallery is provided for visitors, although there is little to attract the attention of the non-technical observer during operations. The most striking feature is a large diagram covering one wall of the room, showing the position of all the principal switches on the system.

(To be continued.)

ELECTRIC IGNITION: COIL AND MAGNETO SYSTEMS.

BY F. H. HUTTON, M.A.

THE subject of ignition for petrol engines used in motor cars is full of interest at the present time, since so many developments have been made in recent years, and so much has been learned with regard to the process of ignition. The articles in the ELECTRICAL REVIEW of November 7th by Mr. C. Sylvester, and of December 12th by Mr. A. C. Booth, are evidence of this fact, and testify to the appreciation of modern battery systems.

Before proceeding further with the subject I should like to enter a mild protest against the title, Coil *versus* Magneto. In these days we seem to have passed the stage when it was a question of only one system surviving to the total extinction of the other. Both systems have been developed to such an extent that they are entirely satisfactory for ignition when well carried out, and it is largely a question of which is most convenient or suitable for a particular purpose.

Mr. Sylvester belongs to the school of those who vote entirely for battery ignition, as evidenced by his remark that "the magneto will in the near future be almost a dead letter," and again, "the same company is utilising the same machinery for the manufacture of magnetos. This is a big mistake, because the majority of its production will never be required."

These are rather sweeping statements. Are they quite justified by the facts?

The high-tension magneto in pre-war days had been developed into a very reliable and efficient machine, which rarely gave trouble. Since those days the magneto industry has been transferred to this country, and has developed and grown in a most remarkable manner. Not only were there about 300,000 magnetos manufactured between 1914 and 1918, but during that time the design was being rapidly improved in nearly every important detail, until the machines as finally turned out were about as good as could be desired. The magnetos that are now being made for motor cars conform to this high standard, and the makers have the benefit of all their war-time experience on the design of complicated aeroplane types. To mention only a few points. The introduction of laminated pole pieces in place of the solid cast shoes formerly employed has greatly improved the low-speed sparking characteristics of the magneto. At the recent Olympia Show machines were to be seen sparking regularly over standard three-point 5.5 mm. gaps at a speed of 50 R.P.M. The new system of cam construction is another important point. Instead of the cams being separate pieces of steel they are now ground out of one piece of steel tubing, the two cams and the cam ring being all one integral part. The cam shapes are formed on special profile grinding machines, and are such as to impart a smooth regular motion to the rocker-arm, this being

necessary at the high speeds at which modern magnetos operate. By this means the flinging and bouncing action of the arm is avoided. Again, the "jump-spark" distributor is generally considered a great improvement; and so on. Nearly every detail has been developed in this manner.

It has to be remembered that motor cars are made for the public, the great majority of whom are not engineers or electricians. What they require in the way of ignition apparatus for their cars is something of the "foolproof" and thoroughly reliable order. They have been accustomed to magnetos for many years, and have been very well satisfied with them on the whole, in spite of the fact that "swinging" the engine is necessary for starting with a magneto, and that this is not a pleasant occupation with a large engine when it is cold and stiff. Again, from the very fact of this swinging being necessary, back-fires, which the average motorist dreads more than anything, are of uncommon occurrence, especially with a fixed ignition point which cannot, therefore, be unduly advanced. Again the older motorist who had some experience of battery ignition in the old days of no dynamos and trembler coils has a holy horror of this kind of ignition, not having realised fully that modern battery systems are an entirely different proposition. Taking all this into consideration, and remembering that we are naturally of a conservative nature in our habits, it does not seem very likely that the average motorist will be in a hurry to throw away his magneto. And what the average motorist wants, the average manufacturer has to provide, if he wants to sell his cars in normal times. Moreover, there are almost innumerable instances where there seems little prospect of the magneto being displaced as a means of ignition, and this field appears to be a rapidly increasing one. To mention a few which come to mind at once: the farm tractor, which is just in its infancy; motor lorries and heavy vehicles of all descriptions; motor 'buses and taxicabs; stationary petrol engines for all purposes, and a host more, for all of which the magneto seems pre-eminently fitted as a means of ignition. From this it would appear that the magneto firms need not at once shut up shop and draw down their blinds.

On the other hand, we have the facts that practically all cars are now turned out fitted with electric lighting and starting sets; that the battery must always be kept in working order for these purposes; that this battery can be used just as well for ignition in connection with a modern closed-circuit system; that starting with battery ignition is very easy, only a very low speed of rotation being necessary; that this is an advantage not only for hand-cranking, but also where electric starters are used; that the spark is equally good over the whole timing range, and can be advanced or retarded as much as desired; that this gives a very useful additional control over the engine and adds a refinement to the performance of an engine which is much appreciated by those who know how to use it; that battery ignition is ideal for slow running, the spark being at its best at low speeds. Using battery ignition we have to remember to switch off the current when leaving the car, and to retard the timing lever before restarting. These items can be dealt with automatically by the introduction of thermostatic switches and ignition governors, but that means bringing in complications which it is desirable to avoid. Now, taking all these facts into consideration, and bearing in mind that battery ignition has for some years been the standard system in the U.S.A., it is difficult to believe that it will not be very largely used in this country also when its merits become better known. Certainly a little more care and attention are required than for magneto ignition, which can be practically neglected. The battery must be looked after, but as that forms an essential part of the lighting and starting systems it is not likely to be neglected for long, and knowledge about batteries will probably become much more general in this country as in America. The extra feeling of control given by the ability to use the timing of the ignition freely is delightful to anyone who has an appreciation of mechanical sense, and likes to feel that he is getting the best result from his engine under all circumstances of speed and load. The contact-breaker, distributor, and coil of a battery system, if properly designed and constructed, are simple, and can be made very accessible. The first two are generally combined and driven by gearing from the dynamo in many modern systems, making one unit with the latter, so that only one driving connection to the engine is required.

Mr. Sylvester in his article mentions how the Remy system was appreciated in the air services, both in this country and abroad, and also mentions the Delco as used on the Liberty engine which was installed on the seaplane N.C.4 when it crossed the Atlantic. Mr. Booth, who has had considerable personal experience of a Delco system, gives it a very good character, and indeed his record of 9,000 miles of running spread over five years without once using the starting handle is remarkable. One point must be remembered. Mr. Booth is himself a skilled electrician, and we must not take quite for granted that the same result would have been achieved if the system had been in unskilled hands. The skilled man may not imagine that he treats his car any differently to another, but all the same there is a difference. A few minutes with a screwdriver or file, a touch here, a clean connection there, the battery not neglected, &c., may not seem anything out of the way to an engineer, but the layman would leave them out, and in the long run they might make a considerable difference.

In case British manufacturers should seem to be neglected in these remarks, I should like to quote a paragraph from Mr. Booth's article with which I entirely agree. "I would prefer to see British industry in the forefront. On the other hand, I have no hesitation whatever in giving credit where credit is due, even though it be to those who are not Britishers, primarily in justice, secondarily with a view to encouraging our own people to do likewise, if they are unable to do better." That is exactly my feeling in the matter.

British manufacturers have not yet had sufficient time to develop battery ignition systems fully, as evidenced by the comparatively small display of them at Olympia, but there is no reason why they should not excel in this line as in the case of magnetos.

The Remy system must be admitted to be a very good example by all who have had experience of it, and was to be seen at Olympia fitted to some high-class cars, from the magnificent Lanchester to the little 3-cylinder Cosmos, on which, by the way, a particularly neat lay-out was provided. In this system simplicity in design has been combined with first-class workmanship.

Mr. Booth raises many interesting points in his timely article, but as these do not all strictly bear on the subject of ignition perhaps a discussion of them should not be included here. Much has been written in the motoring Press on magneto and coil ignition, but the opinions expressed are generally strongly prejudiced in favour of one system or the other, and it is difficult to find any well-informed and unbiased pronouncement. So far as the present article is concerned, whatever may be thought of the views expressed, they are at least straightforward impressions put forward without any partiality or preference for any particular firm or system.

Excess Profits Duty.—The Board of Referees has considered an application by the River Plate Electricity Co., Ltd., for an increase of the statutory percentage as respecting the business of supplying electric light and power in the Argentine Republic. The Board has made an order increasing the percentage in the case of any trade or business carried on or owned by a company or other body corporate to 9 per cent. with additional percentages in the case of other trade or business as specified in the order. A similar order made in respect of the Bogota Telephone Co., Ltd. (the business of supplying public telephone service in the Republic of Columbia), increases the percentage to 7½ per cent., with additions in specified cases.

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THE ELECTRICAL TRADE OF INDIA.

We have already dealt generally with the report by H.M. Trade Commissioner in India (Mr. T. M. Ainscough, O.B.E.). We desire to repeat our advice that the report should be carefully studied, and below we make a few extracts:—

American Competition. Competition from the United States is becoming particularly keen in electrical machinery, mining machinery, steelworks plant, oil-crushing and refining machinery, machine tools, and miscellaneous engineering supplies for industrial purposes. Before the war, British makers had such a hold on the trade, largely on account of the fact that purchases were usually made in London by the managing agents of Indian industrial concerns, and also because British engineering practice and standards were preferred, that foreign competition made little headway. During the past four years, however, orders have had to be placed in the United States for immediate requirements, and it is likely that the American connections, having once been made, will be retained, and we must regard this competition as being permanent. So far, very few American manufacturers have opened offices in India, but their representatives are very active, and buyers are being inundated with catalogues and literature of all kinds. Mention should also be made of the value to American industry of having American engineers at the head of some of the largest industrial ventures in India. (A number of instances are given in the Trade Commissioner's report.)

The effect of the break in the supply of the British product will probably extend for many years, inasmuch as the plea will be made that, in order to secure homogeneity of plant, future extensions should also be obtained from the makers of the original machines. The influence of engineers in responsible positions is also very great outside the sphere of their own works. There were in India, before and during the war, no firms of consulting engineers, as this work was almost entirely done in London. Consequently, the advice and opinion of the chief engineers of successful industrial undertakings is eagerly sought by the rulers of native States and the promoters of other ventures. The leading British industrial firms in Calcutta are also now engaging the services of trained British engineers on their staffs to advise them with regard to new plant, and it is to be hoped that more British engineers will come out to India in a consulting capacity. The openings are very great for specialists of all kinds, particularly for highly qualified mechanical and electrical engineers, with a thorough knowledge and experience of modern industrial practice and organisation.

How to Combat it. The leading groups of electrical machinery makers already possess strong local branches in the leading centres, and there is a thoroughly representative Indian Committee of the British Electrical and Allied Manufacturers' Association in Calcutta. One prominent firm is believed to be proposing to erect works in the country. In view of increasing American competition, particularly in hydro-electric enterprises, makers of suitable plant should take steps to strengthen their position, and manufacturers of the smaller allied products would be well advised to associate themselves for selling purposes with one or other of the principal groups, so that they may receive the advantages of the group's technical knowledge and selling organisation on the spot, and also to enable the group to quote for a complete installation. In view of the considerable developments which are taking place in India in the use of water power for industrial purposes, many of which are already either in progress or projected, it is essential that British makers of water turbines, generators, transformers, and all the lesser articles which make up a complete plant, should be strongly represented. Very severe competition will be experienced from the United States, and it must not be forgotten that the engineers of some of the largest hydro-electric schemes in India, who have great influence on the placing of orders, are Americans who were formerly in the employ of our principal American competitors.

Coming Industrial Development. Very large extensions are planned for iron and steel works plant, power plants of all kinds, particularly electrical, improved mining machinery, complete machine shop equipment, and complete installations of textile (cotton, woollen, jute, and possibly silk) mills, flour and paper mills, sugar refineries, oil pressing and refining mills, glass works, chemical works, oil-well equipment and pipelines, shipbuilding yards, tanneries and leather factories, soap works, paint works and cement plants, not to mention the repairs and renewals and considerable extension to public works, railways, and the postal, telegraph, and telephone services.

One point, in particular, should be borne in mind by the British manufacturer, and this is the necessity for quoting for the supply and erection of a *complete plant*.

Trend of Import Trade. In our issue of December 26th, 1919, detailed figures were given of India's import trade in electrical goods. The following remarks by Mr. Ainscough should be read in conjunction with those statistics.

Philips's Dutch-made lamps have obtained a firm hold, and Japanese lamps of all kinds have entered the market. The demand for electric ceiling fans, and to a lesser degree for desk fans, is increasing rapidly, and will continue to do so. American and Italian makes are the best known, best advertised, and most actively sold fans on the market. There is a great opportunity for the British maker in this direction if only he will make the goods in strict accordance with the wishes of his representatives on the spot. As regards heavy cables, British makers, owing to their reputation and excellent selling organisation in India, are able to hold their own; but, in the finer wires for house wiring, the Japanese maker has come to stay. As a rule, the Japanese productions are not equal to the British makes, but during the war India has been only too glad to accept any quality in order to satisfy her demands. There is little doubt that we shall regain the greater portion of this trade, but there will be keener competition than before, and Japan will probably retain a great portion of the bazaar trade. British standard marks should be carefully watched against infringements. A complete range of samples of Japanese electrical accessories in the Indian market, with a full report on them, may be seen by interested firms at the Department of Overseas Trade.

Local Electrical Manufacture. The manufacture of electrical machinery such as dynamos, motors, transformers, &c., has not yet been attempted in India on account of the difficulty of obtaining the requisite material. After experiment it would doubtless be possible to produce suitable cast iron, but there is no immediate prospect of producing from indigenous sources the thin iron core-plates, electrolytic copper wire and sections, cotton yarn and tape, and press-spahn. The cotton tape and yarn required must be made from fine counts, entailing the use of long-staple cotton, and the finished product must be entirely free from dressing and of uniform dimensions. This has not yet been produced in India.

A certain amount of switchgear for direct current has been manufactured in India during the war, and the results reflect great credit upon the firms concerned, the gear comparing very favourably with similar imported articles. The difficulties of manufacture have been great, as, with the exception of pig-iron for the castings, recourse has had to be made to imported copper sheets, brass bars, &c., and in almost every case it has been necessary to utilise such material as was obtainable rather than that which would normally have been used. All small pins, screws, nuts, springs, and washers have had to be manufactured, either by hand or upon unsuitable machinery, and this has resulted in increased cost of production and the sacrifice of interchangeability.

A notable achievement has been the successful production of electrical porcelain, the insulators now produced in India being in every way equal in quality to the usual imported types. None were made in India before the war, and if the existing factory is extended to supply insulators in large quantities the imports will be considerably affected. If electrical porcelain becomes readily available, factories could be established for the manufacture of such accessories as ceiling roses, tumbler switches, wall plugs, cut-outs, distribution fuses, &c., all of which are at present imported.

All such electrical fittings as watertight lanterns, deck fittings, ironclad plugs and sockets, hand-lamps, table lamps, plain glass globes, and the like, are now manufactured in sufficient quantities to meet the present curtailed demand. It is stated that in many cases they are superior to the imported article, and only in rare instances is there a marked inferiority.

No attempt has been made to produce insulated conductors and insulating materials (except porcelain), and the whole of the requirements have been met from imported stocks. The rubber now produced in Southern India, however, is of very high grade, and eminently suitable for electrical purposes, and there is no insurmountable obstacle to be overcome for the production in India of all types of insulating materials and insulated conductors.

Negotiations have been proceeding for some time with a large British electrical company for the erection of works at Sakchi for the manufacture of lamps, motors, and the more simple types of electrical machinery. In addition, a prominent Calcutta firm is starting a workshop for the manufacture and repair of certain classes of electrical machinery.

Prompt Return of Railway Wagons Urged.—While it is most important that additional wagons should be placed on the railways in order to relieve the present congestion which is seriously hindering the trade of the country, that is not the only way in which a remedy may be found. We are sure that traders will give sympathetic consideration to the appeal which appears in our advertisement pages to-day in which it is urged that if wagons were rapidly unloaded, released, and returned expeditiously, the result would be equivalent to getting more trucks on the railways.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The New Cable Standards.

I am obliged to you for inserting my letter in your issue of December 26th, and forgive you the printer's error "B & G" for "B & S" gauge. My promotion to the rank of captain also occasions me surprise, but I will not suggest that this is premature until a search in the records has been made.

The Institution's acceptance of 1/.044 in. wire for ordinary sub-circuits in house wiring will probably occasion a feverish demand for this size, which my firm, and presumably others, will lay themselves out to meet. Up to now it has ranked with 1/20 S.W.G. as little more than an embellishment to the list of V.I.R. cables, so that for a week or two the supply may not equal the demand. However, we will all do our best.

Meantime, there will be many wiring firms—and wiremen also—who will be shy at using the smaller 0.0015 sq. in. cable (1/.044 in.). The extra cost of wiring with the next new standard size, .002 sq. in. (3/.029) will be considerable, and 1/18 S.W.G. (1/.048), the old friend of the competition wiremen, should not be forgotten. I predict that it will be manufactured and used for many years yet in spite of the new wire standards.

The cost of wiring per point with 1/.044 in. will not be much less than with 1/.048 in., for there will be no gain in the cost of labour, and there is no doubt that the work with 1/18 will be better. Incidentally, it is of interest to compare the cost of 1/.044 inch C.M.A., and that paradoxical cable N/A-C.M.A., with that of 1/18 of equal qualities of insulation but larger copper section made by non-C.M.A. firms.

But those who want altogether non-association 1/.044 in. for low-priced wiring work shall have it in as large quantities as they desire, now that the I.E.E. has blessed it.

For the
Edison Swan Electric Co., Ltd.,
F. CHARLES RAPHAEL,
Manager Cable & Wire Department.

Ponders End, Middlesex.
December 31st, 1919.

In many of the letters you have published recently, the most important advantage of the new method of describing the size of cable has been overlooked.

I understand that it is intended that each size shall be described by its nominal sectional area in square inches, instead of by the number and gauge of the wires, thus 7/20 will be known as .007 or 19/16 as .06.

At present, in calculating cable sizes, it is necessary first to decide on the area, and then to translate that area into number and gauge of the wires, but with the new lists it is only necessary to order cable of a certain sectional area (except in the case of .003, which may be either 1/16 or 3/20).

It is difficult to learn a new way of describing an article of everyday use quickly, but I have proved for myself that the new method of describing cables by sectional area saves a great deal of time and trouble, and I am confident that the new system will be a great advantage to the industry.

W. Cross, M.I.E.E.

Newcastle-on-Tyne.
December 30th, 1919.

The "Lesco" Holder.

Lesco, Ltd., have supplied me with a sample of their new pattern lampholder, which is certainly ingenious. I have called their attention to the fact that the weight is taken entirely on two small indentations in the top part of the holder. This, I think, would not be safe, if the holder was hanging up in a high public building, and supporting, say, a heavy Holophane shade. Something more mechanical than two little indentations would be needed to make the holder entirely safe. This is more important, in that the holder is made from light spinnings and not from castings. The makers state that in actual use much of the weight is taken off the indentations by the fact that the top part is a tight fit. In the sample which I have, however, this is not the case, and the weight is really taken entirely on the indentations. My own feeling is that the lampholder would not be safe where there is any corrosion, such as happens in damp atmospheres.

It would be interesting to have the opinion of other engineers on the subject.

C. Turnbull.

Electricity Works,
North Shields,
January 5th, 1920.

The Fuel of the Future.

With reference to "Economy's" letter in your last issue, in which he reproaches me for not being broad-minded, apparently he did not read the opening sentences of "The Fuel of the Future and the Gas Companies," for it was stated therein that it was written because the B.C.G.A. were endeavouring to persuade the public that by using gas one was utilising the nation's coal in the most efficient way. The way is not closed to "Economy" to save the remaining 80 per cent. of the coal heat value by my article; all it has done is to show that as electricity is already more efficient than gas, a saving in the process will make it overwhelmingly so. If "Economy" will read his letter carefully he will see that he is in complete agreement with me, for in pointing out that it is the 80 per cent. waste of heat at the stations that must be corrected, he has obviously dropped gas out of his calculations. Therefore, if I am not broad-minded, he falls into the same category.

B. L. Klemens.

Blackheath, *January 5th*, 1920.

REVIEWS.

Principles and Practice of Electrical Testing. By R. G. Allen, B.Sc., A.R.C.Sc.I., A.M.I.E.E. Pp. 363, 286 figs. London: Messrs. Longmans, Green & Co. Price 18s. net.

The title hardly does justice to the scope of this work, since several of the earlier, and in many respects the most interesting, chapters deal with general theory concerning continuous and alternating-current circuits. These chapters take the form of a mathematical treatment of a series of problems and theorems from which much useful information may be obtained.

Coming to the part dealing with testing proper, we first find the measurement of high, low, and medium resistances fully described. Modern direct-reading commercial instruments are exemplified by an account of the "Megger" set for insulation testing, though no mention is made of the important adaptation of this instrument for the measurement of low resistances. Particular attention is paid to the measurement of insulation resistances of "live" systems.

Magnetic measurements with regard to permeability and core loss are next fairly completely dealt with, though the double yoke method, which permits of permeability tests on straight bars (or even on bunches of laminations) by the ballistic method, is not described.

Succeeding chapters deal with the measurement of temperature rise, inductance, and capacity, and follow usual lines.

A large amount of space is devoted to machine tests, and a full account of the methods available for measuring losses, efficiency and regulation, and for the determination of the various characteristic curves of generators and motors (for continuous and alternating currents), of converting plant, and of transformers is given.

An excellent feature of each test is that tables of results obtained from typical machines are given for the use of readers in furtherance of their studies. With regard to these tables an important criticism may perhaps be made, namely, that many of the columns or lines are not sufficiently labelled, only the symbol of the quantity concerned being given. Of course, in many cases this will be sufficient to identify both the quantity and the unit, but a much better plan is to label clearly each column with the name of the quantity, the name of the unit, and with the symbol (or formula by which the quantity is derived). The possibility of misunderstanding is then adequately prevented.

As will be gathered from the account already given, the book covers a very wide range of matter, the most notable omission being supply meter testing.

The diagrams, which have obviously been specially drawn for the book, are clear and well reproduced. The work will be useful to students of electrical engineering who have completed an elementary course, particularly if they have received a good mathematical training.

Water-power in France.—Mention is made of tidal power projects in France and of the new French law on water-power developments of all kinds. Experiments with a view to utilising tidal power are to be made under Government auspices in St. Briac Bay on the north coast of Brittany. The new law provides that no one may utilise tidal or other water-power without a State concession. Natural and artificial waters, canals, rivers, and lakes are included. In order to avoid legal work and expenses which would be prohibitive in the case of small concerns, the latter are exempted from the new law so long as the maximum power does not exceed 50 KW. There were in the basin of the Seine in 1910 some 149 hydro-electric equipments serving village lighting; of these, 36 were from 2 to 10 H.P.; 43 from 11 to 20 H.P.; 23 from 21 to 30 H.P.; 13 from 31 to 40 H.P.; and 8 from 41 to 50 H.P.—*Technical Review.*

BUSINESS NOTES.

Trade with South China.—Those of our readers who are interesting themselves in trade with South China will find a long account of a visit paid to Swatow, Foochow, and Amoy by H.M. Commercial Secretary at Hong-Kong, in the *Board of Trade Journal* for January 1st.

American Foreign Trade.—Mr. J. P. Morgan's company has formed the Foreign Commerce Corporation of America, to carry on foreign trade. It is proposed to devise new means for continuing America's foreign commerce. The new concern will probably act in close co-operation with the Foreign Finance Corporation; both concerns, says the *Times* Financial Correspondent at New York, are backed by tremendous capital resources. They "may well be regarded as the vanguard of a systematic invasion of the world's foreign trade fields, and particularly those of Europe."

New Capital Issues of 1919.—Statistics issued by the London Joint City and Midland Bank, Ltd., give the following, among other totals, of the new capital issues during the past two years, and during the month of December, 1919:—

	1918.	1919.	Month of Dec., 1919.
Commercial, industrial, &c.	£10,877,199	£92,591,207	£11,071,697
Electric light and power	1,56',760	3,604,088	1,900,000
Iron, coal, steel and engineering ..	15,513,073	24,635,948	3,315,312
Telegraphs and telephones	—	5,455,000	4,555,000
Tramways and omnibus	133,900	1,449,247	—

Trade with Japan.—Mr. E. F. Crowe, C.M.G., H.M. Commercial Counsellor in Japan, is now in this country, and he will shortly make a tour of the provinces for the purpose of being interviewed by manufacturers and merchants who desire to obtain information to assist them in understanding the Japanese market, and in developing their overseas trade. Firms desiring to meet Mr. Crowe should communicate with the Department of Overseas Trade, 35, Old Queen Street, London, S.W. 1.

E.T.U. Members' Income-Tax.—At the Westminster Police Court on December 31st, according to the *Daily Telegraph*, more than 50 members of the Electrical Trades Union were summoned for non-payment of income-tax due on quarterly assessments. The men had been employed at the National Aircraft Factory, Waddon, near Croydon. Mr. R. T. Rayner, the collector for the district, said the whole of the cases has been under the consideration of the men's Union, and had been the subject of appeal to the Commissioners of Inland Revenue. The result was that the assessments were confirmed, and amended notices were served finally on August 12th. The men claimed as expenses a travelling time allowance of 4s. a day, which was paid by the firm each day. In addition they were paid 1s. a day travelling expenses.

Mr. Lark, solicitor, who appeared for a number of the defendants, asked for an adjournment in order that he might consult the Somerset House authorities. He had a letter from a superintending collector to the effect that the men were not to be assessed upon the actual cost of travelling to and from their work.

Mr. Rayner said the 4s. a day was claimed by the Commissioners as money earned.

The magistrate, Mr. Leycester, adjourned the cases for 21 days, so that the men might have evidence that the matter had received full consideration.

A Chinese Trade Bureau.—The British China Trade Bureau (Publicity Bureau for South China) has been transferred to the Federation of British Industries. The transference of the London organisation of the Bureau from its offices in Regent House, Regent Street, to the headquarters of the Federation is a step in the direction of practical co-operation between manufacturers and merchants. This Bureau was an organisation set on foot to provide an essential link between the home manufacturer and the distributing merchant in China on the one hand, and a consuming population of 50 millions of people on the other. It was realised that if British enterprise was to make headway against the powerful trade propaganda of the Japanese in this market, some form of counteracting activity had become necessary for British trade. The Bureau established its own organisation throughout the four provinces of Kwangtung, Kwangsi, Yunnan and Kaeichow, with the result that to-day it exercises a controlling influence over nearly 100 newspapers published in the vernacular. Amongst its other activities it is prepared, free of charge or commission, to introduce British manufacturers at home to British merchants in China, or *vice versâ*. The Bureau has in its possession a mass of valuable information relating to market conditions throughout the regions in which it operates. The new direction of its activities in London will be placed under the superintendence of Mr. Henry Hobden, who is now in charge of the China Section of the Overseas Trade Organisation of the Federation, and who was under Sir Arthur Steel-Maitland, in the Department of Overseas Trade, where he had charge of the Far Eastern Section.

Copper Prices.—MESSRS. F. SMITH & CO. report January 6th:—Electrolytic bars, sheets, wire rods and H.C. wire no change.

MESSRS. JAMES & SHAKESPEARE report January 7th:—Copper bars (best selected), sheets and rods, £167, an increase of £10.

Auction Sale.—By order of the Disposals Board (Ministry of Munitions) Messrs. Allsop & Co. will sell by auction on January 16th at Hollywood Lane, Fulham, a quantity of electrical fittings, building material, &c. See our advertising pages to-day.

Electric Lamp Charges.—The Middlesex Profiteering Appeal Tribunal dismissed an appeal by Messrs. Watson, Marsh and Co., Ltd., Brondesbury, against an order of the Willesden local committee to refund 2½d. of 10½d. charged for an electric bulb. The local committee argued that a reasonable profit would be secured by the sale of the bulb at 8d.—*The Times.*

Lead.—MESSRS. JAMES FORSTER & CO. report under date January 3rd:—

Since our report of December 20th, we have had seven market days with a turnover of about 20,000 tons, and an advance of £6 a ton—a record unsurpassed both in quantity and values. That speculation has had much to do with the position which exists to-day cannot be denied. Without it values would not have increased as they have done, but it is equally true that the intrinsic position is such that nothing could have prevented a large increase in price .... The market closes at the top, £46 5s. for April, and £45 17s. 6d. for January, and we wish we could think it would not go higher.

MESSRS JAMES & SHAKESPEARE report that the price of English pig lead on Wednesday, January 7th, had advanced to £43, an increase of 50s. for the week.

A Milan Market.—We are informed by the BRITISH ITALIAN CORPORATION, LTD., of 12, Nicholas Lane, London, E.C. 4, that preparations are being made for holding a Trade Fair in Milan, from about April 12th, 1920, for a fortnight. The fair will not be an exhibition, a place where each exhibitor sets before the public only his best productions, but a market where producers of all nationalities can show to the trade, samples of their productions, and where buyers can ascertain in the shortest time and with the least trouble what goods are being produced, the terms and quantities offered, and the conditions of delivery. The stands offered are shops measuring 3·50 × 3·50 metres (about 11½ ft. square) floor space, completely enclosed, roofed in and with glass fronts, but not furnished. Sixty such stands are reserved for British producers and manufacturers. Roofed sheds and outdoor open spaces are also offered for machinery and large exhibits. The above Corporation has been appointed agent of the Fair Committee for the British Empire, and is authorised to deal with applications for space, &c.

British Trade-Mark Applications.—Appended is a summary of the recent applications for British trade-marks in respect of productions connected with the electrical trades and industries:—Thermaglio. No. 392,781. Class 18.—Electric heating, cooking, and lighting apparatus. Industrials, Ltd., 55, Effra Road, Brixton, S.W., June 27th, 1919.

Pat. No. 393,579. Class 6.—Electrically-operated machine tools. W H. Clifford, Baron Clifford of Chudleigh, Madeley Road, Ealing, W., July 23rd, 1919.

Wizard. No. 395,038. Class 8.—Electric batteries, cells, and accumulators. Falk, Stadelmann & Co., Ltd., 85-87, Farringdon Road, London, E.C., September 9th, 1919.

Design, comprising small black circle with streak of lightning across. No. 393,623. Class 8.—Electric batteries. Siemens Bros. and Co., Ltd., Palace Place Mansions, Kensington Court, London, W. July 25th, 1919.

W. Co., Ltd. (initials of firm embodied in design). No. 392,879. Class 50.—Electrical fittings, &c., all made of wood). The Woodfyt Manufacturing Co., Ltd., 3, Ogle Mews, Upper Marylebone Street, London, W., July 2nd, 1919.

Automac. No. 396,254. Class 13.—Sparking plugs. Picard, Dobson & Co., Ltd., 536, Claremont Road, Rusholme, Manchester. October 20th, 1919.

Challenge. No. 393,609. Class 13.—Sparking plugs. The Challenge Manufacturing Co., Ltd., 41, Summer Row, Birmingham, July 25th, 1919.

Sparkite. No. 391,283. Class 13.—Vibrators, contacts and points for circuit making and breaking devices used on ignition systems. K. W. Ignition Co., 2,811, Chester Avenue, Cleveland, O., U.S.A., UMay 5th, 1919.

Electrical Manufacturing in India.—A new company has lately been formed in Calcutta with the title of the Electric Apparatus Manufacturing Co., with a capital of 500,000 rupees.

Charge of Theft.—At Leeds West Riding Court, on December 30th, Vincent W. T. Bradshaw, of Sunderland, and George Edward Pearson, of Farsley, were charged with the theft of electric switches and electric cables, to the value of £394, from the Barnbow munition works. Bradshaw had been before the Court a fortnight previously, when the case was adjourned for inquiries. Mr. F. J. F. Curtis, on behalf of the Public Prosecutor, said Bradshaw had made a voluntary statement, which implicated other persons. A further charge of conspiracy was made against both defendants, and Pearson was also charged with stealing a 25-H.P. electric motor, three fuseboards, and a transformer. Mr. W. R. Wilson (representing Pearson) asked for a further remand for a fortnight, and said his colleagues for Bradshaw and the Public Prosecutor were agreeable. The Court, therefore, granted the further fortnight's remand, Bradshaw being allowed bail in £1,500, and Pearson in £2,000.

Engineering Exhibition at Olympia.—The Machine Tool Trades Association is organising its second International Engineering and Machinery Exhibition to be held at Olympia from September 4th to 25th. The exhibition of machine tools and small tools is to be restricted to members of the Association, but a certain amount of space is still available for other exhibitors. The offices are at Queen Anne's Chambers, Tothill Street, Westminster, S.W. 1.

Coal Mining in India.—Quite a large number of committees are sitting to consider questions affecting the expansion of industries in India. They include committees on coal production, and purchase of stores. In the meantime a summary of a report by Mr. Trehearne Rees, of Messrs. Forster, Brown & Rees, London, to the Secretary of State, on "Indian Collieries" has been issued at Delhi, says Reuter's Trade Service. Mr. Rees states that one-third of the coal in Indian coal mines is at present being lost by bad methods of mining, while three-quarters of a million tons are lost annually by the wasteful power working of collieries. The proposals contained in the report include the filling in of old workings to enable more complete extraction of coal, large organised schemes for improving conditions of labour so as to settle non-fluctuating labour populations near the mines, central electric power generation on a compulsory non-profit basis, modern coking and utilisation of by-products, colliery-owned sidings and light railways, and briquette manufacturing.

Belgian Electrical Industry.—A special department of the Ministry of Industry and Work has been called into being to assist the re-establishment of the electrotechnical industry in Belgium. It is styled l'Inspection de l'Industrie, and has published details of the former and present status of the electrotechnical industry. Before the war, it appears, electrical manufacturing firms were 41 in number, employing 8,695 workmen. Most of these firms were systematically plundered during the German occupation, and especially the larger ones, stocks of raw materials and finished goods being alike removed; only the smallest firms in certain districts escaped, the Germans apparently being minded to compensate themselves for our blockade by this method of action. The work of reconstitution has consisted, in part, in the recovery, where possible, of the machinery carried away, and in part, in the acquisition of new plant. The sum of these efforts is such that a recovery of 50 per cent. of the state before the war has been made, but only half of the workmen are at present employed on production, the rest being engaged in works of restitution. The actual recovery for the whole country being thus only about 25 per cent. The province most injuriously affected is that of Antwerp, that least affected being Brabant, on account of the secondary importance of the pre-war electrical undertakings there. The staff now employed numbers 4,275, and is steadily increasing. According to moderate estimates, the works may regain their normal productive capacity within the current year (1919), if no break in the supply of raw material, machinery, and labour supervenes. The acquisition of new supplies is, however, difficult, and emphasis is laid on the hindrance met with in the execution and cost of orders placed abroad, and it is considered that allied countries should make some sacrifices on behalf of their fellows in Belgium, if only for the selfish motive to preserve future access to this market. Notwithstanding the enormous difficulties met with in furnishing themselves with raw materials, and with the laudable desire of escaping from German subserviency, the Belgians have started six new works—one at Liége for fusible plates and cable clips; a glow-lamp factory at Deurne-Sud; a machine tool works at Brussels; a mine-signal works, &c.; these six works, with those previously existing, make a total of 47, which form the subject of the Governmental inquiry.—*L'Industrie Electrique.*

Swedish Electrical and Engineering Trade.—The *Financier* reports that, according to an inquiry that has been set on foot by the Electrical Industry Association of Sweden, the Swedish electrical industry has made splendid progress during the years of war. The combined share capital of Swedish electrical industries, which amounted to about 50 million kroner in 1914, has at the present moment reached a total of 230 million kroner. The total output value of the trade was about 20 million kroner in 1914, and would seem to have come to about 100 million kroner in 1918. However, it is anticipated that the industry must be fully prepared to meet much keener competition in the near future, both in the home and export markets.

It is reported in the daily Press that, as the result of trouble in Swedish engineering industry, 12 Stockholm factories, and three in the provinces, have closed down. It is expected that 16 more provincial factories will do likewise. Later reports indicate a large extension of industrial dislocation.

Electricity Works and Shortage of Plant.—The Electrical Development Association has been interesting itself in the deficiency of plant which is experienced by many undertakings, and would like to hear from those who are embarrassed in this way.

The British Industries Fair at Birmingham.—The arrangements for the British Industries Fair (Birmingham Section), to be held at Castle Bromwich Aerodrome, from February 23rd to March 5th, are approaching completion. The exhibitors number 650, and 100 000 sq. ft. of space has been taken. Plans for hospitality and entertainment to overseas buyers have been made. The chief feature will be general hardware and engineering—the latter being represented by 200 firms. All classes of brass foundry are to be adequately covered, particularly in relation to hot and cold water, gas and electric light fittings, and, in view of the national housing schemes, it would appear that manufacturers are paying special attention to the claims of builders' ironmongery, grates, gas ranges and stoves, and to electrical radiators and other electrical appliances in domestic use. The section devoted to chandeliers, candelabra, gas fittings, electric light fittings and accessories, and lamps of all kinds, including electric pocket lamps, is extremely well covered, and interesting developments are promised by enterprising firms. The tube industries, which cater largely for the gas and electric undertakings, promise a big display.

French Electrical Companies.—The German Alsatian company Elsässischer Kraftwerke has been converted into a French company, under the style of the Forces Electriques Alsaciennes. Its headquarters are at Schlestadt, in Alsace, and with a capital of 1,500,000 marks, it works centrals at Kapeltenmuhlen, Markolsheim and Schlestadt. It has lately been engaged in expurgating the German members from its board of management.

The Energie Electrique du Littoral Méditerranien has decided to raise its capital from 60,000,000 to 100,000,000 fr., in order to carry out sundry extensions and improvements tending to raise its capacity to 150,000 H.P., equal to a yearly output of 380,000,000 KW.-hours.

La Verrerie Scientifique is the style of a company established at Paris for the making and sale of X-ray tubes, and all apparatus of precision in glass and quartz. Its capital is 160,000 fr.

A company called the Etablissements Alba has been launched at Paris whose objects are the manufacture and sale of electro-mechanical apparatus. Its capital is 100,000 fr.

The Appareillage Electro-Industriel, which recently raised its capital to 1,500,000 fr., has now decided to add to its title the names "Petrier, Tissot et Raybaud."

The Société d'Eclairage Electrique des Automobiles, whose offices are at Courbevoie, has gone into liquidation.

£600,000 Thrown Away.—After being closed down for over five months, the Ebbw Vale Steel and Ironworks resumed operations on Monday. The works closed down last July, following a strike of skilled tradesmen. The stoppage cost the company £250,000, and the loss to workmen directly affected was another £250,000, in addition to a loss of wages amounting in all to about £100,000 to men who were not directly affected, making in all £600,000.—*Financier.*

What is a Pint?—The old Winchester gallon, long ago abolished here, is still in use, with its corresponding pints and quarts, in the United States of America. The difference (20 per cent.) is a handicap to both the British and the American exporter of commodities sold by measures of capacity. The Decimal Association wishes to collect specific examples of confusion, difficulty, loss of trade, or loss of money arising from this difference, and, in the interests of the British export trade, invites those interested to submit such examples to the Secretary, 229-231, Finsbury Pavement House, London, E.C. 2.

Catalogues and Lists.—CREDENDA CONDUITS CO., LTD., Chester Street, Aston, Birmingham.—Illustrated leaflet giving prices and descriptions of "Creda" electric irons and kettles.

AUTOMATIC AND ELECTRIC FURNACES, LTD., 281-283, Gray's Inn Road, W.C. 1.—Leaflet dealing with output and energy consumption of metal furnace pots for use with Wild-Barfield electric furnaces. Also Bulletin No. 17, entitled "The Location of Hardening shop Faults."

THE ENGINEERING APPLIANCE CO., 22, Cricklewood Lane, N.W.—Leaflet describing the E.A.C. charging panel for accumulator work.

BRITISH INSULATED AND HELSBY CABLES, LTD., Prescot and Helsby.—*Catálogo de Cables*, 50 pp. A priced and illustrated list, in Spanish, of cables of various types.

MESSRS. FALK, STADELMANN & CO., LTD., Efesca Electrical Works, 83-87, Farringdon Road, E.C. 1.—Catalogue No. 445 (24 pp.), giving illustrations, descriptions, and prices of "Efesca" lanterns and accessories.

THE BENJAMIN ELECTRIC, LTD., Brantwood Works, Tariff Road, Tottenham, N. 17.—A card, entitled "A New Year's Resolution," advertising the "Benjamin" reflector.

THE CHLORIDE ELECTRICAL STORAGE CO., LTD., Clifton Junction, Manchester.—A 24-page booklet dealing with "Exide" and "Clifton" portable accumulators and electric hand lamps. Priced and illustrated.

MESSRS. SIEMENS BROS. & CO., LTD., Palace Place Mansions, Kensington Court, London, W. 8.—Two battery showcards in colour have been issued. Both are available for merchants and traders on application. The larger one (approximately 18 in. × 11 in.) illustrates a selection of Siemens dry cells and batteries suitable for bells, telephones, indicators, &c., and gives a view of a portion of one of the battery shops at the works at Woolwich. The smaller card illustrates various sizes of dry cells for pocket lamps, torches, &c., a bird's-eye view of the Woolwich works appearing in the centre.

THE OVERSEAS ENGINEERING CO., LTD., 75, Curtain Road, E.C. 1.—List No. 46, an illustrated price-list of "National" motor starters.

MESSRS. MATTHEWS & YATES, Swinton, Manchester.—Lists Nos. 2/1, 103/1, and 128, dealing with "Cyclone" air propellers, electric blowers and exhausters, and electric vacuum cleaners.

Canadian Industries Exhibition in London.—An exhibition, exclusively devoted to Canadian industrial enterprises, is to be held in June next in London. It has the support of the Canadian Trade Commission, the Canadian Manufacturers' Association, and the Canadian Mission in London, and its organisation is in the hands of Mr. H. Greville Montgomery. Most of the ground floor space at the Royal Agricultural Hall has been definitely allotted to leading firms. Information can be obtained from the offices, 43, Essex Street, Strand, W.C. 2.

All-British.—A British Order in Council requiring that managing directors of British companies in China must be of British nationality, is reported to have given rise to feeling among Americans, as a number of our companies are managed by them, and they will have to leave their positions at 60 days' notice.

New Bombay Power Company.—THE TATA POWER CO. is the name of a company which has lately been formed in Bombay with a capital of 90,000,000 rupees to undertake the supply of electrical energy for power purposes.

Book Notices.—Scientific Paper No. 353 of the Bureau of Standards: "Variation in Direction of Propagation of Long Electromagnetic Waves." The observed direction of radio waves as obtained with a direction-finder varies with time when long waves are used, such as those from very high power stations. The variations of direction are of the order of 90° for very long waves. No such large variations are found for short damped waves produced by spark apparatus. A method of increasing the sharpness of determination of direction has been worked out. A theoretical explanation of the variations of direction is given, based on the existence of media in the earth's atmosphere capable of reflecting and refracting the waves. Washington: Government Printing Office. Price 5 cents.

Scientific Paper No. 354 of the Bureau of Standards: "Principles of Radio Transmission and Reception with Antenna and Coil Aerials." The functioning of the two principal types of radio aerials is worked out quantitatively from fundamental electromagnetic theory. Experiments have verified the formulas and conclusions presented. Formulas for the current received in either antenna or coil aerial in terms of current in either type of transmitting aerial are given, as well as comparison formulas giving the relative performance of antenna and coil aerials under various conditions. The advantages of the condenser-type of aerial are presented. The theory and nature of radiation are discussed, and applied to the elucidation of some current fallacies. The basic principles of design of aerials are given. Desirable lines of future research are pointed out. The use of the coil aerial as a direction-finder, interference preventer, reducer of strays, and submarine aerial are not among the subjects treated. Washington: Government Printing Office. Price 10 cents.

Scientific Paper No. 351 of the Bureau of Standards: "The Dependence of the Input Impedance of a Three-Electrode Vacuum Tube upon the Load in the Plate Circuit." Because of the capacities between the electrodes of a three-electrode vacuum tube, the input impedance, which determines the input voltage supplied to the grid of the tube by the apparatus in the input circuit, depends upon the electrical characteristics of the plate or output circuit. In this paper theoretical relations are established which permit the input impedance to be calculated when the impedance in the plate circuit is known. These relations are also checked by experiment. Washington: Government Printing Office. Price 5 cents.

"Safety for the Household." Circular No. 75 of the Bureau of Standards, U.S. Department of Commerce. Washington: Government Printing Office. 127 pp. Price 15 cents.—This is a very complete "safety-first" publication, setting forth the necessary precautions to be taken in the every-day applications of electricity, &c. The first half of the book deals with electrical fixtures and wiring, and gives in minute detail methods of guarding against such accidents as shocks from lighting circuits, burns from arcs emanating from broken connections, and also warnings as to the dangers attending the inexperienced handling of fallen overhead wires. The proper voltages of various household circuits are given, special attention being paid to private lighting and power sets. Directions for the resuscitation of persons rendered unconscious by electrical shock are fully set out, the treatment of cases of lightning shock receiving separate notice. Following this is a section dealing with the use of gas, and giving descriptions of most of the usual accidents caused by carelessness in its employment, and the precautions necessary to avoid such occurrences. Treatment of asphyxiation cases is described very fully. A special note is made of the proper use of acetylene gas, with directions for the proper and safe storage of calcium carbide. The next section is devoted to the causes and prevention of fires; practically every way in which a fire may be started is detailed, and methods of prevention are suggested. Hazards arising from the use of chemicals then receive notice, and the concluding section is a compendium of miscellaneous risks and safeguarding measures which are a part of every-day life. The circular is well illustrated and indexed for quick reference.

Scientific Paper No. 355 of the Bureau of Standards: "The Determination of the Output Characteristics of Electron Tube Generators." Owing to saturation and rectification effects in three-electrode vacuum tubes, the currents which they deliver to any type of output circuit, when used as a generator, are heavily loaded with harmonics. Experimental results indicate that the frequency of the oscillating currents generated is the natural frequency of the output circuit. Hence this circuit behaves as a filter in series with the tube and the D.C. power system, and the useful output current is approximately sinusoidal, whatever the distortion of the tube currents, depending in amplitude solely upon the fundamental constituents of the tube currents. General expressions are derived for the power and current output in terms of static characteristics of the generating tube, and are corroborated by experimental results obtained with a particular tube. Washington: Government Printing Office. Price 5 cents.

"Colliery Manager's Pocket-Book Almanac and Diary for 1920." London: Colliery Guardian Co., Ltd. Price (in cloth) 3s.—This is the 51st annual edition of the pocket-book, a fact which almost renders further comment superfluous. The book being severely practical, the political alarums and excursions of the past year find no place in it, but the technical mining progress effected during 1919 is surveyed, and this section includes an interesting discussion of problems met with in electric shot-firing, which have been investigated. The use of underground conveyors in South Wales is favourably spoken of, but these appear to be worked by compressed air. Abundant statistics are given; we note that electric safety lamps in 1917 numbered 146,651, out of a total of 747,570, while the majority of the flame lamps were lighted electrically, and more than half the total had magnetic locks. Coal-cutters, driven by electricity, numbered 1,739, and by air 2,060; but over 16 million tons of mineral were got out by the former, and less than 12 millions by the latter. On January 21st, 1918, the electrical equipment of British mines aggregated 913,640 H.P., mainly underground. An excellent electrical section of 49 pages is given, but, curiously enough, we have not been able to discover any reference to the coming-into-force of the regulations in respect of plant installed before June 1st, 1911, on January 1st this year.

"All About Anthracite: the World's Premier Coal." By A. L. Summers. London: The Technical Publishing Co. Price 7s. 6d. net.

"Treatment of Harmonics in Alternating-Current Theory by Means of a Harmonic Algebra." By A. Press. Berkeley: University of California Press. Price $1.

The National Union of Manufacturers (Inc.) has issued a 16-page pamphlet giving, alphabetically arranged, names of members enrolled between August, 1919, and November, 1919.

Calendars, &c.—From the CONSOLIDATED PNEUMATIC TOOL CO., LTD., 170, Piccadilly, London, W. 1, we have received a wall calendar with monthly sheets, which are held down at bottom by an elastic holder. Each sheet has a fair-sized illustration of a Consolidated tool.

MESSRS. DOWNES & DAVIES, of 1 and 3, Stanley Street, Liverpool, have issued an attractive wall calendar with a study in colour of "Miss Springtime," already acknowledged here as the favourite patronised by another firm.

MR. GEORGE ELLISON, of Perry Bar, Birmingham, has issued a large wall calendar, with monthly slips below a richly coloured study of a woman. Beside the slips are neatly given the addresses, 'phone numbers, &c., of the firm's six branches in this country, and at foot the interesting announcement is made that Ellison's are also in evidence at Paris, The Hague, Copenhagen, Moscow, Milan, Burgdorf, Johannesburg, Sydney, and Christchurch (N.Z.).

From the HILLBAR PRESS, of 76, Finsbury Pavement, London, E.C. 2, we have received a wall calendar with monthly sheets for 1920.

From the COMMERCIAL ELECTRICAL ACCESSORIES, LTD., of 9, Diana Place, Euston Road, London, N.W. 1, we have received a very serviceable desk blotting pad and calendar, with diary (interleaved with blotting) on the left-hand side, while down the right side there is a column of dates for the week with an indicator for changing daily. Any reader can have one of these pads on application to the company.

MR. FRED. H. JENNINGS, of 74, Cinder Bank, Netherton, Dudley, sends us an advertising device in the form of a Treasury-note wallet.

From MESSRS. W. H. WILLCOX & CO., LTD., 38, Southwark Street, London, S.E. 1, we have received a calendar in their usual style, with monthly turnover sheets.

Touring Exhibitions.—Sir Hamar Greenwood, M.P., Secretary to the Department of Overseas Trade, states that by way of supplementing the British Industries Fair, the Department is considering the possibility of starting a number of "movable shops" and touring exhibitions abroad in the interests of British trade. This is a revival of an idea which was discussed a good deal in pre-war years, both for rail and shipping exhibition purposes. The proposal is deserving of the fullest discussion among the trades, and we shall probably refer to the subject more fully later. These travelling exhibitions should, in our opinion, be accompanied by kinema sections for the display by industrial films of the operations in progress in our great engineering, electrical, and other factories where articles can be shown in course of manufacture.

Electrical Company's Claim Against War Office.—According to the *Morning Advertiser*, the hearing of the claims made by the International Electrical Co., Ltd., to the War Losses Commission for compensation in respect of War Office occupation of their premises at Kilburn, from April, 1918, to March, 1919, was begun in December. The claims include amounts of £1,350, for loss of profits, with an additional claim of £2,300 for the training of unskilled labour, £3,000 for depreciation, and an item of £900 for re-decoration. The first claim, the loss of profits and the cost of training unskilled labour, was dealt with by the Commissioner (Mr. W. F. Hamilton, K.C.) on December 19th. After hearing evidence the Commissioner stated that he considered there had been disturbance in the working of the company because of the military occupation. He intimated that before making any determination as to compensation he must read the whole of the evidence put before the Commission on previous occasions.

The Fixation of Nitrogen.—According to the *Financier*, the Aniline Organisation, composed of most of the leading German chemical factories, has doubled its share capital, which now amounts to more than 600 million marks, in order to build new factories for the production of nitrogen fertilisers. The process to be used is the invention of Prof. Haber.

Prices Advance.—THE STERLING TELEPHONE AND ELECTRIC CO., LTD., have issued notice to the trade to the effect that owing to the continued advance in wages and manufacturing costs, they have increased the advance on their current catalogues from 33⅓ per cent. to 50 per cent., subject to certain exceptions. The advance was to come into force as from 7th inst. A gummed slip has been issued for use in current catalogues.

Trade Announcements.—The British Electrical Federation and most of its member companies have returned from the Manchester Hotel, to 88, Kingsway. As part of the building has been retained by the Government, the Federation engineering and stores departments will for the present be located at 11-13, Southampton Row, while the Electrical and Industrial Investment Co., and other finance companies will be at 4, Broad Street Place, E.C.

THE B.E. CO. (OF LONDON AND BIRMINGHAM), LTD., have altered their telegraphic address to "Ubbecolita," Cannon, London.

MESSRS. FINLAYSON & FRASER have commenced business as electricians at 11, Warden Street, Dingwall.

MR. WALTER T. KEETLEY, who is taking up the post of engineer and manager to the City Service Garage, Ltd., automobile and electrical engineers, Smith's Bank Chambers, Market Place, Derby, wishes to receive price lists.

The Great War Exhibition at the Crystal Palace.—The Crystal Palace is to re-open in May this year with the Great War Exhibition. We are informed that there are 50,000 sq. ft. of exhibiting space unappropriated on the ground floor (garden side), which has been reserved for an engineering and electrical exhibition. Manufacturers should communicate with the General Manager, Crystal Palace, S.E., if they are interested in the matter.

Liquidations and Dissolutions.—NEW ST. HELENS AND DISTRICT TRAMWAYS CO., LTD.—Winding-up voluntarily. Liquidators, Messrs. H. P. Conibear and E. H. Edwardes. Meeting of creditors at 5, Fenwick Street, Liverpool, January 16th.

D. HULETT & CO., LTD.—A meeting of creditors was called for January 7th, at 1, Walbrook, E.C. 4.

CRAMPS PATENT REVERSIBLE TURBINE, LTD.—A meeting will be held on February 2nd, at 5, Copthall Buildings, E.C., to hear an account of the winding-up from the liquidator, Mr. F. W. Seel.

PNEUMATIC TOOL CO., LTD.—A meeting is called for February 6th, at Egyptian House, Piccadilly, London, to hear an account of the winding up from the liquidator. Mr. H. L. Williams.

OULTON BROAD ELECTRICITY CO., LTD.—Meeting called for February 23rd, at Suffolk Chambers, Lowestoft, to hear an account of the winding up from the liquidator, Mr. A. Garratt.

S. T. PEMBERTON & CO., electrical engineers, 8, Church Street, Birmingham.—Mr. S. T. Pemberton and Mr. E. Marples have dissolved partnership. Mr. Pemberton will attend to debts.

PAYNE, BUSSEY AND SABBERTON, motor, electrical and general engineers, and ironfounders, Palace Street and St. Martin-at-Palace Plain, Norwich.—Messrs. C. R. Bussey, F. A. P. Payne and A. Bussey have dissolved partnership. Messrs. C. R. and A. Bussey will attend to debts.

JESSE ROPER & CO., plumbers and electricians, 82, Park Street, Peel Green, Patricroft, Lancaster.—Messrs. J. Roper and T. Grundy have dissolved partnership. Mr. J. Roper will attend to debts.

Unions Fraternising.—As a result of a Conference with the Parliamentary Committee of the Trade Union Congress last week, an agreement was reached between the National Association of Theatrical Employés and the Electrical Trades Union in regard to a dispute between the two organisations. The Electrical Trades Union set out to organise electricians in theatres and operators in kinemas, and the Theatrical Employés' Association questioned its right to do so. Each Union has now agreed to recognise the other's membership card in the industry.—*The Times.*

Italian Company.—For the manufacture of and trade in magnets and other electrical apparatus, the Fabbrica Italiana Magneti Marelli has been formed at Milan, with a capital of 7,000,000 lire.

LIGHTING AND POWER NOTES.

Accrington.—SALARIES.—The remuneration of three superintendents and four shift engineers has been considered. Their present salaries are:—Superintendents, with war bonus, &c., £277; senior shift engineer, with war bonus, £248; other shift engineers, with war bonus, £235. The following revised rates are now recommended:—Superintendents, £330; senior shift engineer, £282; other shift engineers, £264.

EXTENSIONS.—The electrical engineer has been instructed to prepare a scheme of mains extensions calculated to meet demands for some years ahead.

Aldershot.—SUPPLY FAILURE.—Owing to a failure in the electricity supply, part of the town was in darkness for several hours on Monday evening.

Bagenalstown (Ireland).—ELECTRICITY SUPPLY.—A number of local traders have combined to provide an electric supply scheme for their premises. The power station is to be erected on the banks of the canal.

Barnstaple.—IMPROVEMENTS IN SUPPLY.—In order to place the electricity undertaking on a proper footing, and to provide sufficient reserve for breakdowns, the Town Council considers it necessary to expend £14,000, as well as a further amount of £1,000 for mains.

Birmingham.—STORAGE-BATTERY INSTALLATION.—In order to cope with the increased demands upon the generating plant, which have necessitated the imposition of many restrictions, the City Council is taking steps to install a storage battery in the Water Street station. The estimated cost, based upon quotations by various firms, plus 10 per cent. to allow for contingencies, is £78,300. The cost of the battery alone will be £53,488.

Blaina.—DELAY IN LIGHTING SCHEME.—It was stated, at a meeting of the Urban District Council, that the lighting scheme was held up in consequence of the failure of Messrs. Lancaster's Steam Collieries Co. to reply to the Council's letter regarding the purchase of a bulk supply. The Council has decided to appoint a deputation to meet the company.

Bolivia.—DEVELOPMENT OF WATER POWER.—The *British Export Gazette* states that a Bill is before the Bolivian Chamber of Deputies for the development of the Republic's water resources, and that a British engineer has been giving advice during the drafting of the Bill. If this British expert's suggestions were carried out, the hydro-electric development of Bolivia would centre round La Paz, Tres Cruces, and Colquechaca. At La Paz it would be used for the Corocoro copper mines, and for lighting, cooking, and heating in the capital itself, a good market thereby being created for materials and appliances of all kinds. Indeed, it is proposed that a depôt should be established for accessories at La Paz. In the other cases, the principal aim would be the development of mining. Altogether, the initial cost of the three installations is estimated at about £2,000,000, but in addition to this there would be much other machinery and accessories required, and, considering the scheme has been formulated in accordance with British ideas, a very large proportion of the plant and material required should be supplied by United Kingdom firms.

Canada.—TURBO-GENERATOR TROUBLES.—In a letter to the *Electrical World*, Mr. J. W. Lightbody, of Calgary, states that much trouble has been experienced in Western Canada through the faulty insulation of the rotor windings, no fewer than five turbo-generators, totalling 10,000 KW., having been put out of commission recently by this defect. These machines are mostly of foreign manufacture, and the makers' drawings show that the insulating materials employed are fuller board and presspahn, which have proved inefficient for this class of work. The defective insulation causes a short-circuit of high resistance in part of the generator rotor-field, which sets up vibration. Later, several turbine-blades are stripped, and the vibration gradually increases until it reaches such a point that it becomes necessary to shut down the machine. In large power plants this short-circuiting, and the consequent high induced voltages, are guarded against by the use of electrolytic cells in parallel with the field windings, and Mr. Lightbody considers that this idea should be applied to smaller generators, as in the latter there is less room for properly insulated coils.

WINNIPEG POWER SCHEME.—Six sets of 28,000 H.P. each are being erected at Du Bonnet Falls on the Winnipeg River, 75 miles north of the city. The cost of this city plant is estimated as being between £1,200,000 and £1,400,000. A chain of stations will eventually be constructed on this river with a total output of over half-a-million horse-power. The Du Bonnet plant will be the largest link in the chain.

Castlewellan (Co. Down).—PRICE INCREASE.—Owing to the increased cost of labour, &c., it has been decided to raise charges for lighting and power by 20 per cent., bringing the cost up to 1s. per unit.

Chester.—ELECTRICITY CHARGES.—The Electricity Committee has examined an approximate statement of accounts for the half-year ended September 29th, 1919, and recommends that, as the present charges appear to be satisfactory, no increase be made during the current financial period.

Chile.—The Santiago Press has recently published some particulars on the authority of one of the directors of the Compania Nacional de Fuerza Electrica, of that company's programme of power generation. The first scheme to be proceeded with is a 30,000-H.P. station to be erected at Maitenes del rio Colorado (branch of the Maipo), near Santiago. Power will be transmitted thence to Valparaiso, and later to Rancagua. As soon as the electrification of the railway from Valparaiso to Santiago is definitely decided upon, the new company hopes to obtain the contract for the supply of electricity.

China.—WATER POWER.—If the provisional plans for the utilisation of the water powers of the Yangtze River materialise, British electrical engineers may be able to secure some important contracts. On the assumption that the flow of the river varies between 75,000 cb. ft. per second at low water and over 10 times that amount during the average flood, it is estimated that a total of 31,000,000 H.P. could be obtained. The scheme includes the construction of seven dams to maintain the river at flood level, and the estimated cost of the whole scheme is £8,260,000.

Continental.—ITALY.—The Consiglio Superiore delle Acque (Water Board) has approved of the important scheme of the commune of Tivoli, associated with third parties, for the development of the waters of the River Ariene. Some 700,000 H.P. of electrical energy will be produced, and the work will be taken in hand forthwith. The scheme is expected to have great influence on the industrial expansion of districts around Rome.

There has been formed at Milan the Elettrica Internationale, with a capital of 2,000,000 lire, for the supply of electricity in bulk.

Società Anonima Idro-elettrica del Sovio is the style of a company formed at Milan, with a capital of 200,000 lire, for the construction and working of electric plant.

According to data collected by the *Italia Elettrica*, the power in kilowatts of electrical plant at work in Italy to-day totals 1,189,679. This is generated to the extent of 815,864 KW. by hydro-electric plant, and 373,815 KW. by steam and other plant. To these figures is to be added the plant existing in Venezia Tridentina and Giulia and in Dalmatia, amounting to a further 117,416 KW., generated for the most part by hydro-electric plant. This makes a grand total of 1,307,095 KW., produced by almost three-quarters of the water power under utilisation. The methods and extent of production vary greatly in each region. Lombardy takes the first place with 332,090 KW., of which 239,164 is generated by water plant and 89,926 by steam. Piedmont comes second with 292,069 KW. of which 258,891 is supplied by hydro-electric works and 33,178 by steam. These figures show that the use of water as a source of energy is greater in Piedmont than in Lombardy, but the latter makes a greater use of steam. The plants in Liguria, Veneto, Tuscany, Umbria, and Lazio are likewise not inconsiderable. Central Italy, on the other hand, is poor in electrical energy. The Basilicata has stations of a total capacity of only 683 KW., Calabria a little over 5,000, and Puglia 8,000 KW. Sicily and Sardinia have only a modest production of energy, being limited as to the former to 27,022 KW., and as to the latter to 7,837 KW. Sardinia and Puglia share the peculiarity of being the only districts in Italy without hydro-electric plant. Of the new provinces of Italy, the wealthiest in electrical energy is the Trentino, which has water plant to the extent of 51,010 KW. and steam of 600 KW.; Venezia Giulia has water plant of 5,605 KW. and steam of 11,896; Dalmatia has no steam plant, but possesses one conspicuous hydro-electric station of a capacity equal to 48,905 KW. These figures refer exclusively to plant at work. For a better estimation of Italian production of electric power there should be set forth the works which are under construction in almost every part of the peninsula, and more especially those using water for generation purposes. Following the essential modifications introduced in the regulations controlling public waters, and the simplification of the procedure for securing concessions, a large number of new concessions have been granted, and the plant in question must shortly commence working. Moreover, the recent provisions establishing a State subsidy in favour of the generation by water of electrical energy, albeit modest in amount, cannot fail to act as a spur to the creation of new undertakings. On the other hand, a larger output of native coal may be utilised for the erection of fresh steam plant.

Fifteen years ago Tuscany possessed no large transmission lines. Small coal generating stations provided energy for lighting to the largest cities only. In 1903 about 9,000,000 KW.-hours were distributed with about 330 km. of line. In 1918 Tuscany possessed 6,000 km. of high and low-tension lines, fed by 10 big new stations of an aggregate power of over 60,000 KW., and distributed 200,000,000 KW.-hours, serving 1,300,000 electric lamps and 12,000 motors. In the western half of Tuscany the current is water generated from the rivers Serchio and Lima, supplemented in the dry season by current from coal or oil-using stations. In the eastern half the energy is principally supplied from a station situated on the river Nera, 200 km. from Florence, and by lignite-fired boiler stations. Two other noteworthy stations are those at Larderello and Orentano, the latter using peat-gas for generating power. A number of minor installations utilise smaller water sources for the service of sundry localities.—*Ingegneria Italiana.*

In consequence of the increase in costs generally, and as an outcome of representations made by leading electric companies, the Italian Government has issued a Decree authorising the raising of the charges to consumers taking up to 100 KW. by 25 per cent., and to communes and State Departments taking up to 1,000 KW. by 15 per cent. Above 1,000 KW. the increase will be 10 per cent. The increase is to run for five years. Another law accords a subsidy of 10 lire per H.P. to new installations begun since January 1st, to continue for 15 years after entrance into working of the plant. New transmission lines having a pressure above 2,000 volts are also granted subsidies for 15 years, as follows:—Lines having a weight of copper above 1,000 kg. per km., 0·15 lire per kg. of copper used; from 500 up to 1,000 kg., 0·20 lire; below and up to 500 kg., 0·25 lire. Where metal electrically equivalent to copper is employed, the same subsidies apply. Like subsidies are also accorded to energy at 2,000 volts taken for use in agriculture or irrigation, while other and smaller subsidies are granted to minor agricultural operations.

RUMANIA.—With a view to utilising the water power which the country possesses, the Rumanian Government has established a department for the electrification of the railway network, the first section to be undertaken being that from Brassow to Sibin. Before carrying out the works, however, a special commission is to go abroad and examine existing installations.

SWEDEN.—Among the new companies recently formed in Sweden in connection with the utilisation of water power and the distribution of electrical energy are the Hede Elektriska Aktiebolag, Heda; the Pjätteryd Hofs Elektriska Kraft Aktiebolag, Vaxjo; and the Rosviks Elektriska Kraft Aktiebolag, of Rosvik.

FRANCE.—The coal shortage continues to occupy the serious attention of the Government and public authorities in France. Some days ago the Est Lumière power company, which supplies the eastern suburbs of Paris, suspended its supply. It has now resumed operations, but the supply is strictly rationed, so that each district in turn has a "lightless day." The power station at Vitry, which serves a large part of the suburbs, was shut down for two days last week, with the result that a series of tramway services were temporarily suspended. In order to economise electricity and coal the Paris Prefect of Police forbade the traditional Réveillon for New Year's Eve in cafés and restaurants. The Municipal Council is to reduce illumination in the main avenues and streets between the hours of 4 and 7 p.m. It is probable that "Summer time" will be introduced on February 1st, and remain in force till October 1st, by which an estimated saving of from 80 to 100 million francs will be effected, largely in the cost of lighting. Power stations are being charged 270 fr. (£11 at normal rate of exchange) per ton for coal, which in Great Britain costs only 45s. per ton.

A company has been formed, under the title of the Eclairage Electrique Légional, with a capital of 500,000 fr. Its objects include the distribution of power to the communes of Pertuis (Vaucluse), La Tour d'Aigues, Cucuron, and Ansouis.

SPAIN.—USE OF WATER POWER.—Recently published statistics show that the number of hydro-electric plants developing over 800 H.P. in 1918 was 85, producing the equivalent of 403,046 H.P. Installations of from 300 to 800 H.P. numbered 50, developing 23,890 H.P. There were 103 smaller undertakings, with an output of 11,394 H.P., making a grand total of 438,330 H.P., which is an appreciable advance upon the previous year's figure—384,297 H.P. Only 14 per cent. of Catalonia's water resources have been utilised up to the present. Works under construction will make use of a further 11 per cent., leaving 75 per cent. unexploited.

BELGIUM.—COMBINED POWER SCHEMES.—La Société Intercommunale Belge d'Electricité has completed plans for the establishment of a large central electricity generating station on the banks of the River Sambre, to meet the increasing demands for current for lighting and power purposes, which is being experienced by the Société d'Electricité du Bassin de Charleroi, and the Société d'Electricité du Bassin du Borinage. The scheme includes the taking-over by the Intercommunale Co. of the existing generating stations of the Charleroi and Borinage undertakings.

Dalton.—POWER SUPPLY.—A Provisional Committee has been formed for the Furness and South Cumberland district, to consider proposals for a central power supply.

The Dalton authorities have issued a circular for the purpose of ascertaining the number of possible consumers in that town. The prices are expected to be from 5d. to 8d. per unit for lighting, 1½d. to 3d. per unit for power, and 1½d. to 2d. for heating and cooking.

Darwen. — POWER SUPPLY.—Darwen Corporation is negotiating with the Lancashire Electric Power Co. for a supply of electricity. It has been decided to supply current to the Walpamur Works for motive power. The Corporation has also approved of application being made to the Ministry of Health for sanction to borrow £27,695 for electricity purposes.

Dundalk. — INCREASED CHARGES. — The Electricity Committee has recommended the following charges, as from January 1st:—Lighting: Private supply, 10d. per unit, subject to Board of Trade approval; contract supply, to be increased by 20 per cent.; artisans' dwellings, raised to 7d. per lamp per week. Power: Up to 250 units per quarter, 6d. per unit; from 250 to 500, 4½d. per unit; from 500 to 1,000, 4d.; from 1,000 to 2,000, 3½d.; from 2,500 to 5,000, 3d.; from 5,000 to 10,000, 2½d. per unit. The charges for heating and cooking will be raised by ½d. per unit, and the contract price per lamp from £3 to £3 10s. per annum. It is proposed to ask prospective consumers to guarantee a minimum payment before making the connections.

Dutch East Indies.—JAVA.—According to the latest estimates, the water power available for generating purposes is at least 5½ million H.P., and the Chief Engineer of the Government Department of Water-power and Electricity advocates greater State developments, in order to supply cheaper power, electrify railways, and to aid irrigation by the installation of electric pumping plants.

Glasgow.—INCREASING DEMANDS.—It is stated that the total output of the Glasgow power stations during the five years of war was greater than that for the 21 years immediately preceding. During the year ended May 31st, 1919, 170 million units were generated. The number of consumers increased during the year by 4,580 to a total of 40,680. The annual coal consumption is 300,000 tons. The two main stations are running with an overload during the winter months, but it is expected to have the new station at Dalmarnock in commission shortly.

Ilford.—DEFICIENCY.—As the Urban District Council has declined to accede to the request of the Government auditor to charge a deficit on the electricity account upon the rates, he has disallowed an item of £10,261. The Council has appealed against this decision.

Japan.—NEW TURBO-GENERATORS.—Two Westinghouse 25,000-KW. steam turbo-generators are being erected for the Osaka Electric Light Co., and will complete the largest steam-driven electrical installation in the Far East. The Osaka Co. installed three 3,000-KW. turbo-units in 1908, two more in 1910, two 5,000-KW. units in 1911, and by the addition of the units now being installed, the total capacity of the station will become 100,000 H.P. The company supplies a lighting load and also power to tramways, steel works, shipyards, copper refining plant, paper mills, electro-chemical plant, and other industries.

TOKIO EXTENSIONS.—The Electric Light Co. has decided to erect an additional power station on the River Sagami. This will bring the total capacity of the company's undertaking up to more than 10,000 KW.

Lampeter.—The Town Council has under consideration an electric light scheme for the town.

Maidstone. — EXTENSIONS. — The Town Council has applied for a loan of £32,000 for work necessary to supply energy for the paper mills of Townsend, Hook & Co., of Snodland; and for a further sum of £1,095 for a high-tension cable for the extension to Tovil.

Newcastle-upon-Tyne.—COLLIERY ELECTRIFICATION.—Many new schemes are in progress in the Newcastle Electric Supply Co.'s area for electrifying collieries. The Seaton Delaval Coal Co. is putting down plant in five pits for main winding, pumping, ventilating, and hauling. The Wallsend and Hebburn Coal Co. is replacing a steam winder by electrical machinery, and is also adopting electric battery locomotives and road vehicles in place of the present steam system. The Stella Coal Co. has decided to install electrical machinery in its Claravale Colliery, chiefly for pumping purposes. Many other concerns are extending their use of power, and the Newcastle Electric Supply Co. is making wide extensions to meet the growing demand, including a 20-mile long, 20,000-volt transmission line.

Peterborough.—LOAN.—The City Council has decided to apply to the Minister of Transport for sanction to borrow £40,000 for the provision of a 1,000-KW. generating plant, and for other purposes connected with the undertaking.

Rotherham.—YEAR'S WORKING.—The borough electrical engineer reports that the total income for the year ended March 31st, 1919, was £108,873, and expenditure £88,359, a gross profit of £20,514. The balance carried to the appropriation account, after payment of loan interest, &c., was £2,514. The total amount of energy sold was 24,623,978 units, the bulk of which (21,744,409 units) was supplied for power purposes.

Salford. — DOCK EXTENSIONS. — In connection with further dock extensions, it is stated that the Manchester Ship Canal Co. intends having additional electrical installations put down.

Price Increases.—PARLIAMENTARY BILL.—Seven electric supply companies are promoting a Bill next session to enable them to exceed the present maximum charges. The undertakings concerned are:—Edmundson's Electricity Corporation, Ltd.; the Electric Supply Co., Ltd.; the Twickenham and Teddington Urban Electric Supply Co., Ltd.; the Penzance and District Electric Supply Co., Ltd.; the Ramsgate and District Electric Supply Co., Ltd.; the Ilfracombe Electric Light and Power Co., Ltd.; and the Camborne Electricity Supply Co., Ltd. The Bill proposes to ensure a dividend of at least 6 per cent. to shareholders per annum by increasing the maximum charge to 1s. 2d. per unit.

Southend.—DIESEL ENGINES.—Four sets of Diesel oil engines, removed from German submarines, have been purchased for use in the electricity works.

Spalding.—SUPPLY COMPANY.—A private company proposes to establish electricity works in the town. The Urban District Council was in possession of a provisional order for this purpose, but the time limit has been passed.

Stalybridge.—PROPOSED COMBINATION.—Acting upon a suggestion recently made by Sir John Snell, the Stalybridge, Hyde, Mossley, and Dukinfield Tramways and Electricity Board has appointed a Sub-Committee to confer with a Sub-Committee of the Ashton-under-Lyne Corporation upon the question of forming a Joint Electricity Authority under the Electricity Supply Act. It is agreed that the interests of both parties would be better served by a supply of power from one station.

Stone (Staffs.).—EXTENSION OF TIME LIMIT.—The Board of Trade has granted an extension of three months from January 8th to the Stone Gas and Electricity Co., in which to carry out the statutory powers with regard to electricity supply.

Todmorden.—PRICE INCREASE.—The scale of charges has been altered as follows:—Lighting—Scale B (maximum demand) for the first 100 hours of the maximum demand per quarter, 7d. per unit; for all units above, 3½d. per unit, plus 35 per cent.; scale C (double tariff), between 4.30 p.m. and 10.30 p.m., 7d. per unit, all other units, 3½d., plus 35 per cent. Heating and cooking —Scale D (flat rate), 2d. per unit, plus 40 per cent. Domestic uses—Scale E, 15 per cent. of the rateable value, and a charge of 1½d. per unit, plus 50 per cent. for all units used. Power—Scales F and G, present prices to be increased by 100 per cent. on July, 1914, rates. General—Scales B, C, and D, to be subject to a minimum charge of 2s. 6d. for each quarter; scale F to a minimum charge of 4s. per H.P. of demand per annum; scale G to be subject to a minimum charge of £1 per annum. Contracts, prices to be 100 per cent. above 1914 rates.

LOANS.—Sanction has been received to borrow a further £960 for an electricity sub-station. Application is to be made for power to borrow a further £500 for electric lighting services.

Torquay.—NEW POWER SCHEME.—The cost of the South Devonshire supply scheme, referred to in our issue of December 26th, 1919, is estimated at £300,000 by the Torquay Tramway Co.'s manager, but a representative of a private company thinks it will cost £400,000 for the generating station alone.

Walsall.—EXTENSIONS.—Owing to the greatly increased consumers' demands, the Town Council finds it necessary to proceed with its extension schemes at the earliest possible moment. In November, 1918, the maximum load was 8,326 KW., since when additional connections, amounting to 1,392 KW., have been made. Outstanding applications will add a further 3,714 KW., and so it is impossible to wait for a fall in plant costs before proceeding with the work.

York.—HYDRO-ELECTRICITY.—The Corporation's scheme for hydro-electric works at Linton Dock has been received with satisfaction by the Ministry of Health, but the Minister intimates that he proposes to defer sanctioning loans until the Council has submitted revised estimates based on tenders provisionally accepted. It is proposed to substitute underground cables for the overhead cables originally proposed, from York to Linton.

PROPOSED SUB-COMMITTEES.—The Electricity and Tramways Committee has recommended the formation of several Sub-Committees to deal with different branches of the electrical undertakings. It is proposed to appoint a Traffic Sub-Committee to attend to all questions relating to the tramways from the public's point of view; a Development and Extensions Sub-Committee which will also deal with charges to consumers; an Advisory Sub-Committee which will settle labour questions, working hours, wages, and conditions. Finally, a Works Sub-Committee is suggested, whose functions will be to attend to all matters relating to the power station, car-shed, mains, sub-stations, and water-power. The arrangements for the supply of energy in bulk will be in the hands of a Bulk Consumers' Sub-Committee.

TRAMWAY AND RAILWAY NOTES.

Barrow. — TRAMWAY PURCHASE.— The Ministry of Transport has sanctioned the borrowing of £107,750 by the Town Council to enable the latter to purchase the Barrow tramway undertaking. A sum of £96,250 has accordingly been paid to the Tramway Co., which relinquished control as from January 1st. The loan period is the maximum permitted by the Tramways Act—30 years—and the Ministry has stipulated that in addition to a sinking fund for repayment of the loan, an adequate renewals fund must be maintained. New cars will be obtained as soon as possible, to relieve the present overcrowding. The Tramways Committee has recommended that the practice of granting passes and reduced fare facilities to certain officials by the former company, be discontinued, only the staff on duty being permitted free journeys. The staff will number 124, and the question of salaries and wages is being looked into.

Blackpool.—TRAMROAD PURCHASE.— One of the largest transactions the Corporation has engaged in was completed on New Year's Eve, when over £240,000 was paid by the borough treasurer in respect of the purchase by the Corporation of the Blackpool and Fleetwood tramroad undertaking, which was handed over to the Corporation on that day.

Bradford.—ELECTRIC PARCEL VANS.—The Ministry of Transport has asked for details of working costs, &c., of the vans which have been in use by the Corporation for some years. These vans are railless trolley vehicles with the addition of storage batteries, which make it possible to employ them on roads not served by overhead wires. It is claimed for these vans that they are the cheapest form of road transport evolved, but their use is limited to a certain extent by the fact that tramway systems are not sufficiently developed in most small towns.

Belfast. — YEAR'S WORKING. — As a result of fare increases, the tramway undertaking has proved financially satisfactory. The total revenue for the year ended March 31st, 1919, was £406,300, as against £355,056 in the previous year. The total working expenses amounted to £257,162, leaving a gross profit of £149,137. After deduction of loan interest, income tax, and other fixed charges, the result was a net profit of £29,231. It is stated that the track is in a bad state, and also that overcrowding on the cars has reached a dangerous point. Fifty new cars were ordered last year, but delivery is not expected for some months.

Continental.—ITALY.—ELECTRIFICATION OF RAILWAYS. —The electrification of the Leghorn Railway will probably be accomplished in 10 years, as it has been decided that the use of low-grade fuels (turf and lignite) for supply is quite possible. The Società delle Torbiere d'Italia is constructing a 10,000-KW. station capable of an output of 40,000,000 KW.-hours per annum. Peat from the Massaciuccoli basin is to be utilised in this station, which has as its main object the supply of current for the State railways. It is intended to electrify the Roma-Sulmona-Castellammare line—a distance of 240 km. For this project a plant of 4,000-KW. capacity will be required, with an average employment of 3,000 hours per annum.

FRANCE.—The river Seine continues to rise, and, owing to the floods, 11 tramway routes from the centre of Paris have been suspended. Many factories have had to close for the same reason.

The electric power station at Jury is flooded, resulting in the stoppage of all tramway-cars to the south-eastern districts.

The Paris Municipal Council refuses to allow advertisements on tramcars and omnibuses, although it was estimated that this would bring in £20,000 annually, on the ground that, although this was done in London, Paris must preserve its originality.—*The Times*.

Enfield.—RAILWAY ELECTRIFICATION.—In a letter to the Edmonton District Council, the G.E.R. Co. states that it is hoped the electrification of the Enfield branch line from Liverpool Street station will be completed shortly.

Ilford.—ELECTRIC VEHICLES.—For the collection of house refuse the Urban District Council is to purchase six electric-battery vehicles, at a cost of £1,325 each.

Jamaica.—KINGSTON STRIKE.—The tramway employés have acceded to the Governor's request to have their claims investigated by a Conciliation Board and to return to work pending the Board's decision.

Japan. — TOKIO UNDERGROUND RAILWAY. — The "Tokio City Co." has been formed, with a capital of 50,000,000 yen (about £5,000,000), for the purpose of constructing an underground electric railway. The formation of the company has been officially sanctioned, and it is expected that the first section, with a length of nine miles, will be completed in three years.

Lancashire.—FARE INCREASES.—The South Lancashire Tramways Co., whose system covers many industrial areas, increased the fares, by permission of the Board of Trade, on New Year's Day. Penny fares have been abolished, the minimum now being three halfpence, whilst other stages have been advanced on an average 25 per cent.

London. — PROPOSED FARE INCREASES. — The Underground Railway companies are seeking power to raise their charges to travellers. The new Bill proposes to abolish "workmen's" tickets and to increase the maximum charge per mile to 4d. first-class, and 2d. for inferior classes. If passed, the measure will double the rates laid down in the "Cheap Trains Act," of 1888. Parcel rates are also to be raised. The Metropolitan Electric Tramways, Ltd., has deposited a Bill for introduction next session to enable it to raise the fare charged on routes in Middlesex, London, and Hertford, to a sum not exceeding 2d. per mile, and also to make the minimum single charge not less than 2d.

Additional alterations in stopping places for tramcars and omnibuses, which have been recommended by the Advisory Committee, for the relief of traffic congestion, and have received the approval of the Ministry of Transport, came into effect on Monday.

It is announced that Mr. S. B. Joel has purchased, on behalf of the firm of Barnato Bros., the entire interest of Messrs. Speyer Bros. in the Underground Electric Railway Corporation. The share capital of the Underground Co., the controlling company in the combine, is £5,000,000, and it is estimated that one million represents the Speyer interest. Another million is held in the U.S.A., and the remaining three millions among British investors and small holders in France, Holland, and Germany.

TRACK SIGNALLING.—On Saturday night last the substitution of the electrically-operated track circuit system of signalling in place of the former manually-operated system was commenced on the South-Eastern and Chatham Railway line from Victoria.

During the rush hour on Monday morning a breakdown on the Bakerloo Tube Railway near the Elephant and Castle, caused about 20 minutes' delay.

Newcastle.—RAILWAY ELECTRIFICATION.—The N.E.R. Co. is contemplating fresh schemes for extending the electrification of lines in the Newcastle area. These include the main line between York and Newcastle, a distance of 80 miles, and also 31 miles of loop-line from Northallerton to Ferryhill, *via* Stockton.

Nottingham.—The Minister of Transport has confirmed the Nottingham Colwick Estates Light Railway Order, 1919 (authorising the construction of a light railway in the parish of Colwick and rural district of Basford, in the County of Nottingham), made by the Light Railway Commissioners.

Yorkshire.—TRAMWAY INDUSTRIAL COUNCIL.—Representatives of employers and employés of the chief tramway undertakings in Yorkshire, Lincolnshire, and North Derbyshire have been elected to form a Joint Industrial Council.

TELEGRAPH AND TELEPHONE NOTES.

Brazil.—The Telephone Co., Rio Grandense, of Porto Alegre, has secured a loan of 2,000 cantos to cancel its floating debt and improve its lines and offices. The loan is contracted by an issue of 13,500 bonds of 200,000 reis' nominal value each, with eight per cent. annual interest and two per cent. annual amortisation.

Chile.—The Chile Telephone Co., Ltd., an English company, secured a concession for 10 years in 1904 to lay an underground telephone service in various cities of the Republic, which concession was extended for another 10 years in 1911. According to the Sociedad de Fomento Fabril, the company has not carried out its obligations, and has taken up an arbitrary attitude towards individual complainants. The Sociedad in consequence has drafted a memorial, for presentation to the Government, praying for the nationalisation of the service, as also of that of electric light and power supply.

Denmark.—At midnight on December 31st, a strike of telephone operators began throughout the country. An emergency service was to be set up with Government telephones, connections being made with the hospitals, police, and fire brigades. This service was to be linked up with foreign cables. In the year 1917-18 there were 385,130,817 telephone conversations, or 131 conversations for every man, woman and child in the country.

Germany.—Telephonic communication between Denmark and Germany has been temporarily completely interrupted by snow and frost, while only one telegraph line to Berlin is working at present. The Lyngby wireless station is also temporarily out of action.

Mexico.—During the past year 15 new telegraph offices were opened for public use. The number of messages sent and received totalled 12,102,286. There were 1,879 km. of new lines constructed, 11,398 km. of lines repaired, and 4,753 km. of damaged line corrected. The extent of the telegraph system of the Republic at the present time is 87,117 km. During the year 76 permits were granted for the construction of private telephone lines.—*T. & T. Age.*

Nicaragua.—The Director General of Telegraphs and Telephones has ordered the construction of a line from Managua to Matagalpa *via* Boaco.

Post Office Engineers.—Owing to the inadequacy of the pay and prospects offered to qualified draughtsmen in the engineering department of the Post Office, especially as compared with the remuneration in the outside world, as many as 21 resignations out of a total staff of 260 have occurred during the past 18 months, and many others are meditating taking a similar step. In view of the altered conditions and the superior attractions outside, the whole scheme of civil service salaries is in need of revision. Otherwise the State will only attract the dregs to its service—a very serious outlook.—*Daily Telegraph.*

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared.)*

OPEN.

Aberdeen.—January 31st. Electricity Committee. Two water-tube boilers, with superheaters, economisers, steel chimney and accessories. (See this issue.)

Bray.—January 30th. Urban District Council. Electricity Works. One 200-B.H.P. Diesel engine, direct coupled to a 135-K.V.A. single-phase alternator and exciter. (See this issue.)

Australia.—SYDNEY.—February 18th. One electrically-controlled tower clock and four dials, for Sydney sub-station. Chief Electrical Engineer's Office, 61, Hunter Street, Sydney.

PERTH, W.A. — February 10th. P.M.G.'s Department. 340 accumulators (schedule W.A.647.) (December 19th.)

Barnes.—January 20th. Urban District Council. Electricity Department. Supply of water-tube boilers, economisers, draught plant, turbo-alternators, condensers, air and circulating pumps, transformers and rotary converters. (December 12th.)

Barking. — Urban District Council. Second-hand air compressor (electric or steam). (January 2nd.)

Battersea. — January 21st. Borough Council. One 5,000-KW. turbo-alternator, with condensing plant; one 1,500-KW. rotary converter; pipework for the 5,000-KW. turbo-alternator; switchgear for the 5,000-KW. turbo-alternator and 1,500-KW. rotary converter. (January 2nd.)

Belgium.—January 17th. Belgian Post and Telegraph Authorities, La Salle Madeleine, Brussels. Telegraph and telephone cables.

Bradford.—January 28th. Corporation. Two electric battery locomotives. (December 26th.)

Chile.—March 15th. Comision de Puertos, Santiago. Electrical machinery (power and lighting) for the Port of Valparaiso. Comision de Puertos, Santiago, Chile. Copies of the specifications can be seen at the Chilean Legation, 94, Gracechurch Street, London, between 3 and 5 p.m.

Cavan.—January 12th. Electric Light & Power Co. Suction gas engine and plant; alternative tender for duplicates, electric generator and motor booster; alternative tender for duplicate, generator, electric storage battery, D.C. switchboard. (December 26th.)

Dundee. — January 23rd. Corporation. Electricity Department. Three 750-KW. converter sets; one 300-KW. ditto; 11,000 V., E.H.T. switchboard; two 750-KW., D.C. control panels; one 300-KW. ditto. (December 19th.)

Halifax.—January 5th. Electricity Department. Supply of stores (including lighting fittings and electrical accessories, cables, meters, &c.), from February 1st, 1920, to March 31st 1921. (December 19th.)

Ilford.—January 27th. Urban District Council. Electricity Department. One 1,000-KW. converting plant, cooling tower, motor-driven air compressor, L.T. cables. (See this issue.)

Kingston-upon-Hull.—January 23rd. Electricity Committee. One 10,000-KW. turbo-alternator, with exciter, and one condenser outfit complete. (January 2nd.)

London.—ISLINGTON.—January 28th. Electricity Committee. Stores, including cables, meters, electric lamps, &c., for 12 months. (December 19th.)

FULHAM.—January 13th. Electricity Committee. Manufacture, delivery and laying, complete, duct, E.H.T. cable, &c., between the generating stations of Fulham and Hammersmith. (December 19th.)

HAMMERSMITH.—January 20th. Electricity Department. Wiring schemes for small property, boiler setting and furnace work, &c. (See notices in this issue.)

STEPNEY.—January 22nd. Electricity Supply Committee. Two water-tube boilers, chimneys, economisers, &c., and one 5,000-KW. turbo-alternator, with condenser, accessories and switchgear. (December 19th.)

CAMBERWELL.—February 2nd. Borough Council. 12 months' maintenance of the private telephones and electric bells at the Town Hall. Mr. F. J. Slater, Borough Engineer, Town Hall, Camberwell, S.E.

Manchester.—January 14th. Electricity Committee. One 2-ton electric lorry (specification No. 23); one 10/15-cwt. electric van (specification No. 24). (December 26th.)

Pontypridd.—January 30th. Urban District Council. Electricity Department. Rotary converter, transformer and switchgear. (See this issue.)

Tynemouth.—January 12th. Electricity Department. Ten 250-K.V.A. transformers. (December 19th.)

Venezuela.—June 30th. The Government *Gazette* of Venezuela publishes a decree inviting tenders for the installation of a wireless telegraphic station near Caracas. (See this column for January 2nd.)

York.—January 20th. Electricity Committee. Tenders for the carrying-out of a hydro-electric scheme at Linton Lock. (See this issue.)

CLOSED.

Accrington.—Corporation:—

For work on the electricity works cooling towers, £2,500.—Peter Brotherhood, Ltd.

Birmingham.—Electricity Supply Committee, Recommended. Storage-battery installation at Water Street power station:

Battery, £53,488.—Tudor Accumulator Co., Ltd.
Boosters, £9,002.—English Electric Co., Ltd.
Switchgear, £1,676.—Bertram Thomas.
Cables and racks, £3,772.—Callender's Cable & Construction Co., Ltd.
Estimated cost of building, £3,250.

Blackpool.—Wiring the new Regent Picture House and the new Bryn Tivy Boarding House. Myles & McCaffery.

Bury.—The Corporation has placed contracts with the undermentioned firms in connection with the pulveriser:—

Electric motor.—Electrical Construction Co.
Cables.—W. T. Glover & Co., Ltd.

Leyton.—Electricity Committee. Recommended:—

E.H.T. switchgear, £874.—A. Reyrolle & Co., Ltd.

New Zealand.—AUCKLAND.—The City Council has recently placed the following contracts for electrical material:—

CABLE.

Section 1.—High and low-tension cable:—
A. & T. Burt, Ltd., Auckland (manufacturers: Siemens Bros.).—£21,644.
Section 2.—(a) Triple-braided overhead cable:—
A. D. Riley & Co., Auckland (manufacturers: Western Electric Co.).—£7,841; (b) rubber cable.—Richardson, McCabe & Co., Wellington (manufacturers: Callender's Cable & Construction Co., Ltd.), £2,227.
Transformers, switchgear and oil filter.—National Electric & Engineering Co., Ltd., Auckland (manufacturers: General Electric Co., U.S.A.), £4,056.
920 ironbark dressed poles.—Redpath & Sons, Auckland, £2,760.
12 tons bitumen.—Ellis & Co., Auckland, £12 10s. per ton (subject to exchange.)
3,280 straight-stem insulators; 800 shackles.—Redpath & Sons, £485.

Todmorden.—Electricity Committee:—

Tank-lowering devices, discriminating gear, and three additional panels.—New Switchgear Construction Co.

FORTHCOMING EVENTS.

Electro-Harmonic Society.—Friday, January 9th. At 8 p.m. Holborn Restaurant. Smoking Concert. (See "Notes.")

Junior Institution of Engineers.—Friday, January 9th. At 89, Victoria Street. At 7.30 p.m. Paper on "Goods Handling and Control," by Mr. C. H. Woodfield.
Friday, January 16th. Chairman's address. "Meteorology and Engineering," by Mr. B. E. Dunbar-Kilburn.

Birmingham and District Electric Club.—Saturday, January 10th. At the Grand Hotel. At 7 p.m. Presidential address by Mr. H. W. Wolton.

Institution of Electrical Engineers (North-Midland Centre).—Tuesday, January 13th. At the Hotel Metropole, Leeds. At 7 p.m. Paper on "Large Power Transformers," by Messrs. A. G. Ellis and J. L. Thompson.

(North-Eastern Centre.)—Monday, January 12th. At the Armstrong College, Newcastle. At 7.15 p.m. Paper on "Scientific Management," by Capt. J. M. Scott-Maxwell.

(North-Western Centre).—Tuesday, January 13th. At the Engineers' Club, Manchester. Ordinary meeting.

(Scottish Centre.)—Tuesday, January 13th. At Princes Street Station Hotel, Edinburgh. At 7 p.m. Paper on "The Electrical Power Supply in the War Zone," by Major T. Rich.

(South-Midland Centre).—Thursday, January 15th. At the University, Birmingham. At 7 p.m. Joint meeting with Midland Junior Gas Association. Discussion on "The Uses of Gas and Electricity for Heating and Power."

(Wireless Section).—Wednesday, January 14th. At the Institution of Civil Engineers, Gt. George Street, S.W. At 6 p.m. Paper on "Wireless Direction and Position Finding," by Capt. H. J. Round.

(Students' Section).—Friday, January 16th. At the City and Guilds College, South Kensington. At 7 p.m. Paper on "The Development of Automatic Telephony," by Mr. J. H. Reyner.

Royal Institution of Great Britain.—Tuesday, January 13th. At Albemarle Street, W. At 3 p.m. Lecture on "Modern Development of the Miner's Safety Lamp," by Sir John Cadman.
Friday, January 16th. At 9 p.m. "Low-temperature Studies," by Prof. Sir James Dewar, F.R.S.

Institution of Civil Engineers.—Tuesday, January 13th. At Gt. George Street, S.W. At 5.30 p.m. Papers on Whitby, Blyth and Sunderland Harbours.

Association of Engineers-in-Charge.—Wednesday, January 14th. At St. Bride's Institute, Bride Lane, E.C. At 7.30 p.m. Paper on "Currency, Finance and Industrial Trading," by Mr. T. E. Gregory.

Society of Technical Engineers (North-Eastern District).—Wednesday, January 14th. At the Subscription Library, Fawcett Street, Sunderland. At 7 p.m. Mass meeting.
Friday, January 16th. At the Corporation Hotel, Middlesbrough. At 7 p.m. Mass meeting.

Faraday Society.—Wednesday, January 14th. At Burlington House, Piccadilly, W.1. Symposium and general discussion on "The Microscope: Its Design, Construction and Application." Exhibition, 2.30 to 4.15 p.m.; Discussion, 4.15 to 6.30 and 8.15 to 10.15 p.m.

Chemical Society.—Thursday, January 15th. At Burlington House, Piccadilly, W. At 8 p.m. Ordinary scientific meeting.

Belfast Association of Engineers.—Thursday, January 15th. At the Technical Institute. At 7.45 p.m. Paper on "Ship Riveting," by Mr. A. J. Lewis.

Paisley Association of Engineers.—Friday, January 16th. At the Technical College, George Street. At 7.30 p.m. Paper on "Electricity and Matter," by Mr. A. McLean.

NOTES.

Electrical Trades Benevolent Institution.—MOVEMENT AT GLASGOW.—We understand that a very strong Advisory Committee has been formed in Glasgow, thanks to Mr. W. W. Lackie, the city electrical engineer, to deal with matters affecting the E.T.B.I. in Glasgow and district. The committee, which is now at work, comprises the following:—Dr. Magnus MacLean (chairman), Mr. W. Roxburgh (hon. secretary), and Messrs. F. Anslow, G. L. Black, A. S. Hampton, W. W. Lackie, Alex. Lindsay, R. B. Mitchell, Arch. Page, J. S. Nicholson, J. E. Sayers, P. J. Sims, E. J. Skinner, and Joseph Taylor. In taking the initiative in this matter, Mr. Lackie has followed the example set by Mr. Hobbs, in Cardiff, which produced admirable results. The Advisory Committees will assist the Institution by reporting on local cases requiring assistance and by obtaining contributions, organising concerts, &c., to assist the funds.

Educational.—IMPERIAL COLLEGE, LONDON.—In *The Times* of December 31st, there appeared a long letter signed by 22 professors of the Imperial College of Science and Technology, advocating the claim of the College to acquire the right to grant its own degrees in science and engineering independently of the University of London, on the grounds that the existing system involved waste of effort on the part of the students, that non-matriculated students were debarred from the degrees of the University, and that the Imperial College was entitled to rank as on a University plane. In *The Times* for January 2nd, Prof. Humberstone opposed the proposal, which he regarded as calculated to weaken the University.

British Oil.—The well at Hardstoft is flowing at an average rate of 2,000 gallons a week; pumping machinery has not been installed. At the present rate of output the yield falls far short of a remunerative value. At the other wells no oil has been met with.

Electrically-welded Ships.—The first electrically-welded ship to be built in French yards has been launched at Caen; the vessel will serve as a floating workshop for the Société de la Soudure Electrique Française, and is 20 metres long, 4 metres beam, and 2·3 metres draught. It will be electrically equipped, and driven by a 35-H.P. motor.

A.C. Telegraphy.—The experimental section of the French Post Office has installed plant at the Brest telegraph office to use alternating current to supply the telegraphic apparatus, and thus avoid the use of accumulators. The installation has given such satisfactory service that it is proposed to apply it in the main telegraph centres. The alternating supply is taken from three-phase mains through a star-star bank of transformers. On the secondary side the current is rectified by a mercury vapour rectifier with three cathodes. A buffer battery is connected between the neutral point of the secondary windings of the transformer and the cathode of the rectifier. Between the battery and the rectifier, an automatic switch disconnects the rectifier leads if the current changes its direction owing to drop of voltage across the rectifier terminals, and reconnects the rectifier to the battery when the voltage rises again. During the period of disconnection the Morse, Hughes, and Baudot telegraphic apparatus is supplied by the buffer battery alone. A red lamp signals this state of affairs, and if it will last for a prolonged period, a reserve battery of cells is brought into use. This battery is always kept ready for use, but the cells are kept dry until an emergency arises. In order that the arc of the mercury vapour rectifier may not become extinguished when the call for D.C. falls below the minimum value that will maintain the arc, a permanent shunt taking from 1·5 to 2 amperes, is connected between the cathode and the neutral point of the transformers. Normally the battery voltage is slightly lower than the rectifier voltage, so that the battery does not discharge, but is slowly charged. If a motor generator set were used to replace the local batteries of the Baudot sets, it could be driven by a D.C. motor connected to the buffer battery. This would simplify the above-mentioned arrangement by rendering the permanent shunt unnecessary, and it would render current reversal impossible and enable the automatic switch to be dispensed with.—*Technical Review.*

Washing Machines: Shortage of Materials.—The manufacturers of washing machines in the U.S.A. produced no less than 500,000 during 1919, representing a sale of £10,000,000. It is doubtful if this output will be exceeded, or even maintained during 1920, owing to the shortage of the necessary parts which are manufactured by separate concerns. The three chief items in washing-machine production are copper and tin sheets, wringers and wringer rolls and motors. The metal sheet manufacturers have not yet got back into their normal position, but it is considered a matter of a few weeks only. Wringer-roll manufacturers are not increasing their capacity, as they consider that the makers of the washing machines will soon produce their own rollers, and thus leave the roller makers with a good deal of practically useless plant on their hands. The total annual small motor output of the U.S.A. is about 1,500,000, and thus a third is required for the washing machine trade. Motors are, therefore, difficult to obtain, and prices are still increasing. The demand for electric washers still exceeds the present rate of manufacture.

The Electro-Harmonic Society.—At the smoking concert which will be held at the Holborn Restaurant, in the Venetian Chamber, to-night, at 8 p.m., Mr. L. L. Robinson will take the chair. The artistes will be:—Mr. Bernard Collins, tenor; Mr. Thomas Howell, baritone; Mr. George Gower, banjoist; Mr. Will Edwards, humorist; Mr. Foden Williams, humorist; Mr. Thomas Sidney, entertainer at the piano; Mr. Bernard Flanders, A.R.A.M., pianoforte solo and accompanist.

Winter Thunder.—The statements about the extreme rarity in this country of thunderstorms during the winter months are disproved by the fact that out of the first 28 days of December, lightning without thunder was reported on three days, and thunder and lightning on as many as 12 days, so that the atmosphere was electrically charged on at least 15 days. On the 4th ult. a number of places in England, Wales, Scotland and Ireland experienced a storm; and on the 19th ult., lightning alone was equally widely distributed. It was laid down long ago that thunderstorms could not occur northward of the latitude of Shetland, but this conclusion has been proved to be erroneous by the numerous instances of Arctic thunderstorms that have been collected and published, showing that they occur all round the polar region up to about latitude 80 deg. When it is remembered that the number of travellers in the inhospitable regions of the Far North has been very small, the frequency of the thunderstorms they have reported is surprisingly large.

Persian Progress.—According to *The Times*, Swiss technicians are being enlisted by the Persian Government for employment on the State railways, telephones, and telegraphs.

Science and International Relations.—The Paris correspondent of the *Morning Post* states that the question whether Allied scientists should renew relations with their German colleagues, has again been raised in Paris. The overwhelming majority of leading men appear to be firmly resolved that, for the present at any rate, they will have nothing to do with German scientists, or even with German science.

M. Emile Picard, the permanent secretary of the Academy of Science, in the course of an interview, said:—Until the scientists belonging to enemy countries manifest in an efficacious manner a new mentality, and until they repudiate all sympathy for those things which raised the indignation of the civilised world (the most shocking of which was the manifesto issued by the "93") it will be impossible for French scientists to renew personal relations with them. We shall continue to hold the belief that science without conscience is merely the ruin of the soul.

Prosecution under the Coal Mines Act.—According to a Sheffield paper, a miner, named Woodcock, has been summoned at the Barnsley West Riding Police Court, for two breaches of the Coal Mines Act in the Stanhope Silkstone Colliery by relighting his safety lamp with the electrical apparatus, which should only be used by authorised persons, and by breaking the padlocks of the apparatus. Defendant admitted relighting his lamp, but said he found the apparatus unlocked. The Chairman said defendant had committed a very serious offence and had jeopardised not only his own life, but the lives of his fellow workers. A fine of 30s. would be inflicted in each case.

Fatalities.—An inquest was held at Lofthouse, Nidderdale, last week, with respect to the death of an electric crane driver named Richard Hubbard (54), who had lost his life through coming into contact with a live wire at the Angrau transformer house in connection with the Bradford waterworks. The voltage was about 2,300, and death was instantaneous. The man had no authority to interfere with the high-tension switchboard, but persisted in doing so after being told to keep off when something had gone wrong. A verdict of "Accidentally electrocuted" was returned.

An inquest was held at Gateshead, on Monday, respecting the death of William Hewitson (49), a cokeyard labourer lately employed at the Marley Hill By-Products Works. Joseph Dryden, who started work with deceased at 10 o'clock on New Year's night, said they began to empty a truck near the pug-mill, which was driven by electricity. Half-an-hour later deceased said he was going to start the mill, and proceeded to the motor-house for the purpose of switching on the current. The pug-mill started, but after revolving four or five times, stopped. Witness went to the motor-house, and found deceased lying dead on the floor clear of the machinery. Dr. Smith said there were small scar burns on the lower part of the abdomen, and he could not see how they could have been caused except by electricity. Mr. W. Diamond, works manager, declared his conviction that death was not due to electric shock received in the motor-house, as the clothes of deceased were not burned, nor were his hands. The energy could not have passed through his clothes without burning them. The Deputy Coroner entered a verdict "That death was due to shock, but that there was no evidence to prove whether it was electrical or otherwise."

A Joint Electricity Authority for Bristol and District.—A meeting of electrical undertakers and County Councils within a radius of about 30 miles of Bristol was convened by the Lord Mayor of Bristol, and held at the Council House, Bristol, on January 2nd, to consider the propriety of promoting a joint electricity authority under the provisions of the Electricity (Supply) Act, 1919. Representatives from the following undertakings were present:—Bristol, Swindon, Stroud, Cirencester, Chippenham, Melksham, Trowbridge, Bradford-on-Avon, Keynsham, Chepstow, Gloucester, Frome, Weston-super-Mare, Cheltenham, Wedmore and Bath, and the County Councils of Gloucestershire, Somersetshire and Monmouthshire. The Lord Mayor of Bristol presided, and at his request, Mr. H. Faraday Proctor (Bristol Electricity Department) explained the provisions of the Act and the scheme which had been tentatively outlined. Considerable discussion took place, and it was ultimately resolved that the councils of the counties, cities and boroughs and other local authorities, and the boards of directors of companies, except as regards the County Councils, authorised undertakers operating within the limits of the proposed district, be requested to pass resolutions agreeing to the formation of a joint electricity authority under the Act, and to forming part of such authority, and in the case of local authorities to authorise their electricity committees to take such steps as may be necessary to carry out the arrangements, including the appointment of representatives on the joint electricity authority. It was further resolved that the authorised undertakers and others affected be requested to pass resolutions agreeing to contribute towards the preliminary expenses on a *pro rata* basis with other authorities, based on the number of units sold within their respective supply areas as per the last annual statement of accounts. An organising committee was appointed to prepare a draft scheme for submission to a future meeting. The following members compose this committee:—Alderman G. Pearson and Mr. H. Faraday Proctor (Bristol), the Town Clerk of Cheltenham, Mr. F. H. Corson, city electrical engineer, Gloucester, Mr. E. T. Gardom, clerk to the Gloucester County Council, Mr F. Teague, city electrical engineer, Bath, the county surveyor of Somerset, and the electrical engineer of Swindon.

Appointments Vacant.—Fitter driver, for the Shoreditch Borough Council Electricity Department; overhead lineman (82s. 2d.), for the Preston Corporation Tramways Department; telegraph inspectors (£250 rising to £300 + £120), for the Government of Nigeria; shift engineer (88s.), for the Radcliffe Urban District Council Electricity Department; laboratory attendant (60s. to 80s.), for the Electrical Engineering and Physical Laboratories of the Sunderland Technical College; assistant mains engineers (350 taels per month), and assistant installation engineers (230 taels per month), for the Shanghai Municipal Council Electricity Department (the present rate of exchange for a tael is 7s. 9d., but this is abnormal); assistant lecturer and demonstrator in electrical engineering (£300), for the University of Sheffield Faculty of Engineering; electrical engineer for the Holmforth Urban District Council Electricity Department; meter room superintendent for the Sunderland Corporation Electricity Department. See our advertisement pages to-day.

Inquiry.—Makers of the "Tank" dry cell are asked for.

Electricity in Mines.—REGULATIONS.—The General Regulations, Part III, Electricity (Section 60), July 10th, 1913, governing the use of electrical power in mines, have reached the time limit set in paragraph 137 (*b*). The latter paragraph directs that all regulations immediately preceding it are to become applicable to electrical apparatus in use prior to June 1st, 1911, on January 1st, 1920. These regulations relate only to underground apparatus except where overhead gear may directly affect the safety of persons in the mines. Cables, switchgear, motors, lamps, and signalling apparatus are fully dealt with. Regulation 137 (*a*) prescribes that exemption from these provisions may be obtained from the Secretary of State in cases of emergency or under special circumstances.

The Lancashire Branch of the National Association of Colliery Managers has resolved to apply for an extension of two years. It is stated that the five years of war, and later the moulders' strike, have made it impossible to comply with the regulations in the time given.

The Slough Motor Depot.—Recently we had an opportunity of visiting the extensive motor vehicle repair works at Slough, at the invitation of the Ministry of Munitions. Much criticism of this depot, some of which may have been deserved, arose both in the House of Commons and in the Press generally, but as we found for ourselves, no one who has inspected the works can help feeling that much of it was premature. It must be admitted that in the early days the prospect was not very inspiring to advocates of national economy, but since then many and varied changes have been made. Although the works are even now incomplete, the restoration and sale of surplus Government owned motor lorries, cars, and cycles is proceeding apace, and when this work has been completed, the Slough depot will be continued as a permanent establishment for the repair and maintenance of Government motor vehicles of all kinds. It bids fair to become an efficient and valuable national asset. At present the output of restored vehicles reaches about 240 cars and 50 cycles per week. The establishment covers an area of some 650 acres, of which 8 acres are covered by one shop alone. When the large number of different makes of vehicles owned by the Government, and the number of parts that make up a single vehicle are taken into consideration the problem of spares and component parts stores will be appreciated. The whole of the works are electrically driven, 3-phase energy being employed, and the distribution being by means of underground cables. The discussion which arose concerning whether the depot should take a supply from the public mains of the local supply authorities or whether, on the score of reliability of supply, should erect a generating station of its own, will doubtless be remembered. Eventually the latter course was adopted, and a station built which, when completed, will contain three Ljungström turbo-alternators rated at 1,000 KW. each, by the Brush Electrical Engineering Co., Ltd. At present the station contains one turbo-alternator of the above make rated at 500 KW., and running at 3,000 R.P.M., 50 cycles, 420 volts. The firing floor of the Babcock and Wilcox boilers is on the ground floor as are also the condensers and the "Sirocco" spray air filters, the turbines and switchboards being placed on the next floor. The various ventilating and dust-extracting fans and exhausters are driven by B.T.H. 3-phase motors, and the electric cranes are by Messrs. Morris, of Loughborough. Messrs. Benjamin Electric, Ltd., are carrying out the electric lighting installation, which has been planned on a scientific basis.

Electrical Developments in Spain.—In a recent report to his Government, the United States Consul-General at Barcelona states that the number of electric plants existing in Spain is now over 2,800, producing annually 54,800,000,000 KW.-hours of energy. As might be expected, Barcelona Province contains the largest number of plants, totalling 500 odd, while the Provinces of Alicante, Valencia, Gerona, and Saragossa come next in order of importance.

Hydroelectric plants in Spain increased from 170 in 1917 to 238 in 1918, whilst the power produced rose from 384,297 H.P. to 438,330 H.P. Of the total in 1918, 85 plants had a capacity of over 800 H.P. each, while 50 hydroelectric installations had each a capacity of from 300 to 800 H.P. Hydroelectric equipment already installed in the great industrial section of Catalonia produces 150,000 H.P., while works are under construction which will yield a further 128,000 H.P., but the total potential H.P. in these cases is 1,104,500, so that 826,000 H.P., or 75 per cent., will still be undeveloped. Four large companies control the power in Catalonia, one of them transmitting to certain stations at 110,000 volts for a distance of 114 miles. During 1918 a hydroelectric plant of 15,000 H.P. was commenced in Asturias, and one of 12,000 H.P. in Valencia, while large plants were also proceeded with in those provinces which had been commenced previously. The difficulties of the coal situation in Spain have in some measure stimulated efforts to utilise the power of waterfalls and mountain streams. Plans are being discussed for the greater application of electricity in the chemical and metallurgical industries, especially in the production of soda and sulphate of ammonia, in the refining of copper, in the treatment of the bauxites of Catalonia, in the preparation of aluminium, and in many other operations of vital importance to the progress of a country. The laws in force in Spain relating to the use of public water power are, however, the outgrowth of legislation of 1866 and 1879, enacted before the advent of hydroelectric enterprises. Rapid development has necessitated numerous additions to the laws, which by their diversity, caused certain misinterpretations. Accordingly, by royal decree, the provisions relative to securing concessions for the use of water power, and the classification of various bodies of water as public utilities, have been co-ordinated, and the Minister of Public Works has also proposed to reframe the law nationalising construction work in connection with water power, giving to the State the right of appropriation of all unworked concessions. It is proposed to divide the country into zones, and require the companies in each zone to form an association, the object being to nationalise the water power now under the control of foreign capital.

Electric railways and tramways were constructed and extended in various parts of Spain during 1918, and plans to electrify the railway from the Asturian coalfields were discussed; it is quite probable that the new road from Madrid to Valencia will adopt electric traction.

An electrochemical joint stock company has recently been formed in Granada to extract ferro-molybdenum and ferro-vanadium. It aims to produce also ferro-silicon and molybdic, tungstic, and vanadic acids, with their derivatives and by-products. This company has an electric furnace which is to be used in connection with the iron and steel production of the great enterprises in northern Spain.

Inductive Interference between Electric Power and Communication Lines.—Reference has been made in our pages to the investigation which has been carried on by the Joint Committee on Inductive Interference of the California Railroad Commission. This committee, it will be remembered, was engaged for a number of years on what was undoubtedly one of the most exhaustive and painstaking investigations ever made anywhere into the phenomenon of inductive interference between electric power and communication lines.

In the course of its investigation the committee compiled a large number of technical reports on many phases of the subject. Owing to the widespread interest aroused, the Commission was asked to publish the most important of these reports for general distribution, and this it has done. The volume is entitled "Inductive Interference between Electric Power and Communication Circuits. Selected technical reports with preliminary and final reports of the Joint Committee on Inductive Interference, and the Commission's general order for prevention or mitigation of such interference.

This publication is of special interest to electric railway, power, telephone, and telegraph engineers, manufacturers of electrical apparatus, and to governing bodies; the volume, bound in morocco leather, and including 1,060 pages, consists of the 30 most important technical reports of the committee, the preliminary and final reports of the committee to the Commission, and the general order No. 52 of the Commission prescribing rules and principles governing the construction and operation of power and communication lines for the prevention and mitigation of inductive interference.

A limited number of copies have been printed in addition to those subscribed for, and are being distributed by the California Railroad Commission, San Francisco, at the actual cost price of $10.00 per volume. Those who wish to secure a copy should place their orders with the Commission as early as possible.

Electrical Dehydration of Crude Oil.—According to the *Electrical Review*, of Chicago, electrical dehydration of crude petroleum has proved to be superior to other methods. When present in the form of large free globules, water will settle out from oil by gravity, but if the water is in a state of emulsion with the oil, it will not settle out at normal temperatures and pressures, even if the mixture be allowed to stand indefinitely. The removal of water at the well effects an important reduction in freight costs, besides eliminating the clumsy practice of allowing purchasers a rebate on the percentage of water which they were able to prove was contained in the crude oil hitherto delivered. There are 17 electrical dehydrating plants now operating in the Whittier district in California, and in many cases oil hitherto unfit for use is made marketable by electrical dehydration. The oil treated ranges from 15 to 50 per cent. of water, and the consumption of electrical energy is about 1 KW.-hour per 18 barrels of dry oil. The electrical dehydration causes practically no loss of gasoline, and the gravity of the oil is raised one or two degrees by the treatment. This increases the value of the oil sufficiently to pay all or part of the cost of treatment. The heating process, on the other hand, involves more or less deterioration of the oil. Careful tests indicate that, under the same conditions, the heating process costs 7.5 cents per barrel, compared with 1.5 cents per barrel (or 2 cents, including royalty) for the electrical process. Usually, the electrical dehydrator operates on single-phase alternating current at 11,000 volts. The emulsion of oil and water is passed between highly-charged electrodes, and the effect of the electrostatic field is to coalesce the particles of water and also coalesce the particles of oil. The water then settles readily by gravity. The average maximum demand per dehydrator is 4 KW., the average load factor 50 per cent., and the average power factor 98 per cent. leading. In districts where water is scarce, the water separated electrically has considerable value.

Forthcoming Exhibitions.—The *Daily Mail* Ideal Home Exhibition which is to be opened at Olympia, London, W., on February 4th, will be the fifth of a series. There will be a full-size reproduction of part of the labour-saving home designed by Mr. C. J. Kay, L.R.I.B.A., which won the first prize in the *Daily Mail* labour-saving home competition. The only coal used in this house is for one anthracite stove to provide hot water; electric hot plates are employed to keep the food hot on its way to the table. In the kitchen there are an electric copper and cooking range, as well as an electric washer and ringer. In the labour-saving section of the exhibition will be shown many devices for lightening house work and doing away with drudgery. These will include an electric dish and plate washer, boot-polishing machine, and other electrical devices.

So large is the number of British manufacturers anxious to take part in the British Industries Fair to be opened at the Crystal Palace on February 23rd, that it has been found necessary to ration the space. Similar fairs are to be held at the same time at Glasgow and Birmingham. The Scottish one will be devoted specially to textile products, and that in the Midlands to hardware. Many thousand invitations have been issued to foreign buyers, and pamphlets in seven different languages have been distributed.

The International Fair, to be held at Brussels from April 4th to 21st, is being organised by the municipality with the financial support of the Belgian Government and the Province of Brabant. There will be important exhibits of electrical machinery, fittings, cables, telegraph and telephone apparatus, &c. The largest portion of the exhibition will be in the Parc Royal, in addition to an open-air space for agricultural machinery and the Palais Midi which will be reserved for large machinery requiring motive power.

The Crystal Palace will re-open to the public in May, 1920, with the Great War Exhibition. H.M. Office of Works has taken the whole of the space on the main floor for naval, military, and aircraft exhibits in connection with the war. On the ground floor 50,000 sq. ft. of space will be devoted to the engineering and electrical section. A feature which will attract attention will be the comprehensive oil exhibition. Full details may be obtained from the General Manager, Crystal Palace, S.E.

Physical Society Exhibition.—On Wednesday and Thursday the 10th annual exhibition of electrical, optical, and other apparatus, was held by the Physical Society, in conjunction with the Optical Society, at the Imperial College of Science, London. Particulars will appear in our later issues.

Electric Furnaces. — The equipment of 20 electric furnaces which, it is said, will form one of the largest electric furnace installations ever made, is now being shipped from the United States to the Glomfjord Smeltverk Co., Norway. Each of the 20 units includes a 1,300-K.V.A. single-phase main power transformer, a 26.2-K.V.A. series transformer, and a 26.2 K.V.A. induction regulator.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Mr. A. LEWIS, of Farington Steelworks, near Preston, late of Cleveland and Durham Electric Power, Ltd., Middlesbrough, has been appointed works superintendent to Doncaster Corporation Electricity Works.

The Swedish Academy of Science has awarded the Nobel Prize for Physics for 1919 to Prof. M. Planck, of Berlin, and Prof. Starck, of Greifwald; the Chemistry Prize goes to Prof. F. Haber, of Berlin.

Mr. J. WILKINSON, M.I.E.E., who recently resigned the position of tramways engineer at Hull, has commenced business on his own account as an electrical and mechanical engineer at 4, Morpeth Street, Hull.

Prof. WILHELM WIEN, of Würzburg, has been appointed successor to Prof. Röntgen, of Munich, whose retirement was recently announced.

At a meeting of citizens, held at Birmingham on January 1st, Sir OLIVER LODGE was presented with an illuminated address and a motor-car, and Lady Lodge with a jewel, in recognition of distinguished services rendered to the University and to Birmingham. The recipients were proceeding on a visit to America.

Lieut. and Acting Capt. G. O. KING, London Electrical Engineers, has relinquished his acting captaincy on ceasing to be employed.

Lieut. J. O. BAIRD, M.C., Tyne Electrical Engineers, has been restored to the establishment of the Territorial Force.

Burnley Tramways Committee recommends that the salary of Mr. MOZLEY (the manager) be increased to £675, inclusive of all bonus, from £575 inclusive.

Mr. W. H. EVANS, foreman of the electrical department of Messrs. Guest, Keen & Nettlefolds, Ltd., of Dowlais, Merthyr Tydfil, having resigned, has been presented by those under his charge with a mahogany clock.

Mr. JAMES WILD, who has been manager of the Ramsbottom tramways for the past six years, has been appointed out of a considerable number of applicants to the position of manager of the Todmorden Corporation motor 'bus system at £300 per annum.

Mr. S. DERWEN JONES, Batley borough electrical engineer, has been granted a war wage increase, bringing his salary to £400 per year.

Capt. H. G. C. TUFNELL, A.M.I.E.E., London Electrical Engineers, has been restored to the establishment of the Territorial Force, of which he was a supernumerary whilst employed in extra regimental duties.

The Leeds City Council has been recommended to approve of the appointment of Mr. J. S. HAMILTON, second assistant engineer, as first assistant engineer of the tramways department at a salary of £500 per annum.

The Liverpool Corporation has been recommended to grant the tramways manager, Mr. C. W. MALLINS, a retiring pension of £660 per annum. Mr. Mallins has been with the Corporation for 22 years, 14 of which he has been manager, and was previously 23 years with the tramways company. He is retiring through ill-health.

Mr. HAYDN T. HARRISON, having completed his work for the Navy, has returned to his previous occupation of consulting electrical engineer. He is to be found at his office, 11, Victoria Street, London, S.W., or at his Research Laboratory, White Horse Lane, Canterbury, where he is in a position to carry out all classes of research and experimental work.

St. Helens Electricity Committee has decided to increase the salary of the electrical engineer (Mr. B. T. HAWKINS) from £00 to £600 per annum.

New Year Honours.—Several names of interest to the electrical and allied professions and industries are to be found in the New Year Honours List, and we have pleasure in tendering our congratulations to the following:—

Sir Albert Stanley, late President of the Board of Trade, upon whom a peerage is conferred.

Sir R. T. Glazebrook, C.B., F.R.S., late director of the National Physical Laboratory, who is appointed K.C.B.

Walter George Gates, assistant secretary to the G.P.O., who receives a C.B.

Sir Henry Birchenough, K.C.M.G., and Sir H. Trevor Dawson, M.I.C.E., M.I.M.E., R.N., upon whom baronetcies are conferred.

James Kemnal, F.R.S.E. (Babcock & Wilcox, Ltd.), who, in recognition of public services in connection with the manufacture of munitions, is made a knight.

Francis Grant Ogivilie receives the honour of knighthood, as do also Hugh Malcolm Robinson, C.B., I.G.O., Chief Inspector of Factories, and Prof. Arthur Schuster, F.R.S., late secretary of the Royal Society.

The appointment C.I.E. is awarded to Matthew Alfred Thompson, Deputy Director-General, Telegraph Traffic, Punjab.

We observe that a thoroughly well-earned peerage has been conferred upon Sir George Riddell, Bart., one of the best-known figures in the newspaper world—a man of shrewdness, foresight, and boundless energy.

Sir David Harrel, who receives the G.C.B., was chairman of the Interim Court of Arbitration, 1918-19, in connection with industrial questions, and chairman and member of Conciliation Boards and Inquiries.

Obituary.—MR. JOHN ORDE.—A familiar figure in Northern electrical engineering circles has been removed by the death, at the age of 59 years, of Mr. John Orde, principal in the firm of Messrs. John Orde & Co., coppersmiths and brassfounders, Newcastle-on-Tyne.

The *E.T.Z.* of December 4th records the death of Dr. M. DOLIVO-DOBROWOLSKY, formerly a director of the A.E.G., and a well-known pioneer in electrical engineering, at the age of 58 years. In the same issue the death of A. LESSING, a pioneer in primary battery manufacture, is reported.

NEW COMPANIES REGISTERED.

Heath Plugs, Ltd. (161,947).—Private company. Registered December 22nd. Capital, £12,000 in £1 shares. To acquire from A. E. Heath a sole licence to use certain patents relating to sparking plugs, to acquire the assets of Heath, Norton & Co., &c. The first directors are: A. E. Heath, 8, Tatcombe Gardens, S.W.4; H. Norton, 56, North Side, Clapham Common, S.W.; H. H. Hassall, 16, Christchurch Road, East Sheen; E. E. Glover, 47, Stanlake Road, Shepherd's Bush, W.; F. E. Preston, 7, Perceval Road, East Sheen. Registered office: 2, Sancroft Street, S.E.11.

Cascoll Engineering Co., Ltd. (162,006).—Private company. Registered December 23rd. Capital, £1,000 in £1 shares. Objects: To carry on the business of mechanical, chemical and electrical engineers, contractors, iron and brass founders, manufacturers of and dealers in motor cars and vehicles, &c. The subscribers (each with one share) are: C. F. Casperson, 54, Shaftesbury Avenue, Roundhay, Leeds, electrical engineer; R. Collins, Warrels Grove, Bramley, Leeds, mechanical engineer. The first directors are: C. F. Casperson and R. Collins. Secretary: C. F. Casperson. Registered office: 20, Garden Street, Marsh Lane, Leeds.

Buglass & Jamieson, Ltd. (10,783).—Private company. Registered in Edinburgh November 29th. Capital, £6,000 in £1 shares. To carry on the business of electrical and mechanical engineers, millwrights' machinists, smiths, motor engineers, &c. The subscribers (each with one share) are: J. F. Buglass, 17, Janefield Place, Dundee, electrical engineer; W. E. Jamieson, 65, Church Street, Broughty Ferry, Forfar, electrical engineer. The first directors are: J. F. Buglass and W. E. Jamieson. Solicitor: Alexander Hardie Buglass. Registered office: 65, Trades Lane, Dundee.

H. F. Stephen, Ltd. (10,847).—Private company. Registered in Edinburgh December 26th. Capital, £10,000 in £1 shares. To carry on the business of electricians, electric light and power and general engineers, &c. The subscribers (each with one share) are: J. Mitchell, 92, Queen Street, Peterhead, fish curer; R. L. Mitchell, Ellishill, Peterhead, fish salesman; J. Mitchell, jun., Longhaven House, Cruden, Abredeenshire, fish curer; H. F. Stephen, Balmoor Terrace, Peterhead, engineer; F. W. Stephen, Morven Black House, Peterhead, fish curer. Minimum cash subscription, £3,500. The first directors are: J. Mitchell, R. L. Mitchell, J. Mitchell, jun., H. F. Stephen and F. W. Stephen. Qualification, 100 ordinary shares. Solicitor: C. G. Masson, 21, Broad Street, Peterhead.

Deans Electrical and Engineering Co., Ltd. (162,269).—Private company. Registered December 31st. Capital, £1,000 in £1 shares. To carry on the business indicated by the title. The subscribers (each with one share) are: H. J. Dean, 19, Leedham Road, Sheffield, eelctrical engineer; R. Lavie, 26, Scarcroft Hill, York, electrical engineer. The first directors are: H. J. Dean and R. Lavie. Qualification, 50 shares. Solicitor: W. Ramsden, Station Street Buildings, Huddersfield.

Commercial Ignition Co., Ltd. (162,156).—Private company. Registered December 26th. Capital, £3,000 in £1 shares. To take over the business carried on by W. Hill and C. J. K. Piggott as the "Commercial Ignition Co.," and to carry on the business of mechanical and electrical engineers, &c. The subscribers are: W. Hill, 85, Lavender Hill, S.W.11, electrical and mechanical engineer, 800 shares; C. J. K. Piggott, 10, Grandison Road, Clapham Common, S.W.11, electrical and mechanical engineer, 800 shares; L. P. Fulkes, 53, Belsize Avenue, Bowes Park, N.22, electrical and mechanical engineer, 400 shares. The first directors are: W. Hill, C. J. K. Piggott, and L. P. Fulkes. Qualification, £1. Secretary: H. Hill. Registered office: 95, Lavender Hill, S.W.11.

Halliwell & Good, Ltd. (162,167).—Private company. Registered December 30th. Capital, £3,000 in £1 shares. Objects: To carry on the business of electricians, mechanical engineers and manufacturers, workers of and dealers in electricity, &c. The subscribers (each with one share) are: C. N. Good, Chesham, Bennett Road, Crumpsall, Manchester, electrical engineer; J. R. Halliwell, 2, Princess Road, Crumpsall, Manchester, electrical engineer. Permanent directors: C. N. Good and J. R. Halliwell (chairman and managing director). Qualification of permanent directors, £250. Registered office: 61, High Street, Manchester.

W. Crookell & Co., Ltd. (162,199).—Private company. Registered December 30th. Capital, £1,500 in £1 shares. Objects: To take over the business of an electrical engineer carried on by W. Crookell at Middleton, Lancs., as "W. W. Crookell & Co." The subscribers (each with one share) are: W. Crookell, Water Street Works, Middleton, electrical engineer; G. A. Toms, 1, Warren Avenue, Cheadle, Cheshire, cashier. W. Crookell is first director. Secretary: W. Proctor. Registered office: Water Street Works, Middleton.

Electrical Depositing Processes, Ltd. (162,100).—Private company. Registered December 24th. Capital, £2,000 in 5s. shares. To acquire plant for the purpose of depositing or forming metals by chemical, electrical or other processes, &c. The subscribers (each with one share) are: C. V. Brearey, "Hartwell," North Farnborough, Hants, engineer; R. E. Rollings, Orlando, Great Northern Road, Dunstable, Beds, engineer. The first directors are: C. V. Brearey, R. E. Rollings, H. Lovelock, H. A. Graves and A. A. Ross. Qualification, 200 shares. Registered office: 19a, Coleman Street, E.C.

Electrical Maintenance Co. (Liverpool), Ltd. (162,072).—Private company. Registered December 24th. Capital, £2,000 in £1 shares. Objects: To take over the business carried on by H. V. Greenep, at Liverpool, as the Electrical Maintenance Co. The first directors are: H. V. Greenep, 133, Upper Parliament Street, Liverpool; E. Durden, 74, Buchanan Road, Seacombe; H. Copland, 1, Buchanan Road, Seacombe; H. Curphey, 8, Rock Lane East, Rock Ferry; C. G. Curphey, Olybane, St. John's Terrace, Seacombe. Registered office: 142a, London Road, Liverpool.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Laing Wharton, Ltd.—Satisfaction registered November 21st, 1919, of charge for £1,000, registered November, 1918.

L. Weekes, Ltd.—Debentures for £1,000, registered November 17th, 1919, charged on the company's undertaking and property, present and future, including uncalled capital.

Bristol Institute of Electro-Therapeutics, Ltd.—Debenture for £400 registered November 18th, 1919, charged on the company's undertaking and property, present and future, including uncalled capital. Holder: E. D. Thomas, 70, Hampton Road, Redland, Bristol.

CITY NOTES.

Adelaide Electric Supply Co., Ltd. The gross revenue for the year ended August 31st, 1919, was £185,908 against £174,254, an increase of 6 per cent. After meeting management and general expenses in Adelaide and London, and providing for debenture interest and sinking fund, £959 is written off cost of issue of "A" preference shares, £3,000 is put to reserve for income tax, £5,000 to general reserve, 6 per cent. paid on the preference shares, 7 per cent. final, free of British income tax (making 12 per cent. for the year), on the ordinary shares, and £1,419 is carried forward plus £16,942 brought forward. During the first nine months of the year (to May last) there was a satisfactory increase in all departments of the company's business. The prospect of a record year was, however, upset by the prolonged strike of seamen in Australia, and the net profit for the year was in consequence seriously diminished, as the authorities imposed drastic restrictions upon the use of electricity, and for a time the supply of current for industrial power was prohibited. The effect of these restrictions was to dislocate the local industries of Adelaide and to reduce the company's sale of electricity by approximately 50 per cent. during the continuance of the strike. Capital expended during the year was £68,946, and there was written off capital account £22,481. The business is rapidly outgrowing the capacity of the existing power house at Adelaide, and a new power station is to be built at Osborne, Port Adelaide; a site has been leased. An issue of new preference shares for this purpose was made last July; the whole of the shares (250,000 of £1 each) were applied for and allotted at par. The development of the business during the year is shown below:—

Year ended	Consumers.	Lighting, &c., in K.W.	Motors rated, H.P.	Total connections in K.W.	Units sold.
August, 1918	21,917	15,856	11,351	27,207	10,775,934
" 1919	25,049	17,629	12,618	30,247	11,239,069

Increase in consumers 14 per cent.; in power supply 11 per cent.; in total connections 11 per cent.; in units sold 4 per cent.; and in gross revenue 6 per cent. The resolution confirming the subdivision of the £5 shares into £1 shares is to be submitted at the close of the annual meeting to-day.

German Companies. *The Bergmann Elektrizitats Unternchmungen A.G., of Berlin*, earned gross profits of 204,000 marks in 1918-19, nearly all of which has been applied to the depreciation of investments.

The A.E.G.-Unternehmungen, A.G., of Berlin, whose share capital of 10,000,000 marks is held by the A.E.G., reports net profits of 702,000 marks (pre-war £35,100) for 1918-19, as compared with 688,000 marks (£34,400) in the previous year, no sum being mentioned for depreciation in either period. It is proposed to pay a dividend of 6 per cent., as in 1917-18.

The Elektrizitats A.G. vorm Schuckert & Co., of Nuremberg, reports gross profits and balance forward amounting to 10,880,000 marks for 1918-19, as compared with 11,249,000 marks in the previous year. The sum set aside for depreciation is 4,269,000 marks, as against 3,500,000 marks, and the balance permits of the payment of a dividend at the rate of 8 per cent., as in the preceding year.

The Deutsch-Uberseeische Elektrizitats Gesellschaft, of Berlin, Buenos Ayres, &c., has issued a financial statement for the years 1917 and 1918. In the former year the gross receipts amounted to 21,644,000 marks, and after meeting general expenses, interest charges and rentals, and placing 4,222,000 marks to depreciation and reserve funds, as against 4,123,000 marks in 1916, the accounts show net profits of 9,178,000 marks, as compared with 10,790,000 marks in the preceding year. It is proposed to pay a dividend of 6 per cent. on the preference shares, as in 1916, and 7 per cent. on the ordinary shares, leaving 7,378,000 marks to be carried forward to 1918, as the results proved to be very unfavourable in the latter year owing to the extraordinary advance in expenses for coal. A loss of 530,000 marks, in fact, occurred at Buenos Ayres in 1918. The total gross revenue in that year was only 7,772,000 marks, rising to 15,150,000 marks with the amount brought forward. After defraying general expenses and other charges there remains a sum of 6,714,000 marks, of which 4,342,000 marks has been allocated to depreciation and reserve funds, and the balance applied to the payment of a dividend of 6 per cent. on the preference shares.

Manx Electric Railway Co.—Sir W. H. Vaudrey presided at the annual meeting held at River Plate House, E.C., on December 23rd. The total receipts for the year were £57,102, against £17,564 in the previous year and £40,160 in 1913. The expenditure was £25,601, as against £11,742 in the previous year and £18,740 in 1913. The result was a net profit of £31,501 against £5,812 in the previous year and £21,420 in 1913. An expert engineer had been called in to confer with the general manager, Mr. F. Edmondson, and it was proposed to extend and improve the plant in various ways. The accounts showed a debit balance forward of £31,411, whereas the profit as shown above was £31,501, thus leaving £90. Allowing interest on first debentures £9,000, there is now a debit balance on revenue account of £8,910.

Southern Canada Power Co.—During the year ended September 30th, 1919, distribution plants were extended to meet requirements of more than a thousand new customers, making a total of more than 9,000. New power development at Drummondville is in successful operation. Gross earnings $566,091 (against $475,009), profits $263,293 (against $210,517), interest $205,229 (against $162,359), surplus $58,064 (against $48,157).

South Wales Electrical Power Distribution Co.—Under the Bill now deposited power is sought to issue £500,000 5 per cent. prior lien debenture stock in addition to £314,148 stock of 1916 which has not yet been issued, in view of the necessary developments for giving requisite supply to industrial and other works and authorised distributors.

Stock Exchange Notice.—Application has been made to the committee to allow the following to be officially quoted:—

Edison Swan Electric Co., Ltd.—360,000 ordinary shares of £1 each, fully paid, Nos. 598,308 to 958,307.

North Wales Power & Traction Co.—According to the *Financial Times*, the profit and loss account for the year ended June 30th, 1919, shows a credit balance of £167 to be carried forward.

Underground Railways of London.—It is announced that Mr. S. B. Joel has acquired the whole of the Speyer interest, estimated at about one million pounds, in the Underground railways group, including the L.G.O.

Capital Increase.—It is announced that the James Keith and Blackman Co. are contemplating an increase of capital by £120,000 in ordinary shares to £250,000. Undivided profits are to be capitalised and distributed among shareholders.

Bell Telephone Co. of Canada.—Quarterly dividend of 2 per cent., less tax.

Mackay Companies.—Quarterly dividend 1¾ per cent., less tax, on the common stock.

STOCKS AND SHARES.

TUESDAY EVENING.

THE volume of Stock Exchange business shows no signs of diminution. The first week of the New Year has brought more and more orders into the markets. The public are buying stock freely. Obviously the Board of Trade statements with reference to the demand that there is for British goods the world over has quickened the imagination of the investor and the speculator. Industrials occupy the principal place in the limelight, and markets are active in nearly all departments.

This applies also to the Home Railway market. The rise which started last week was further continued until checked by the attitude of the railwaymen in regard to the Government's proposals as to wages. The remarkable deal whereby Barnato interests have acquired the Speyer holdings in the Underground Electric Railways Co. has aroused as much interest as the proposal to raise fares has created protest. From the point of view of stockholders, it may be remarked that fares on the District Railway, as an example, are still low, and that travellers would have little cause for complaint if the rates were raised, provided accommodation were found for the passengers. To cite one instance, the first-class season from Hammersmith to the City in pre-war days was £2 a quarter. It is now £2 4s., a rise of 10 per cent. Manifestly it would not be unreasonable if this sort of rate were to be put up, although the season ticket-holders would certainly have reason for demanding that they should receive in return a prospect of getting a seat. Prices have improved in consequence of the Barnato deal, the Underground Incomes and the £10 shares rising 10s., and the shilling shares 11s. 3d. Districts are ½ higher; so are Metropolitans. Both the latter have been better still, giving way in sympathy with declines in the steam stocks on the railwaymen's protest.

There are few changes in electricity supply prices. County of London at 9¾ are ¼ better, but the preference fell an equal amount to 9½, while City of London preference at 9½ and Charing Cross ordinary are 2s. 6d. up. A good deal of attention is being focused upon the relative advantage of ordinary or preference shares. Investment has become such a mixed problem that the old landmarks, safety on one hand and speculative possibilities on the other, have been almost swept away. The recent flood of new issues has had the effect of diverting money from the more sober securities which pay 6 per cent. or thereabouts on the money, and turning the capital into channels that offer 7, 8 or even more per cent. We are steadily approaching the time when the investor will either insist on 10 per cent. on ordinary shares, or he will be content to put up with some Post Office rate of interest from issues that promise large capital appreciation in the near future. These influences pull strongly in the Stock Exchange tide which moves quotations, and the tendency at present is certainly to realise the better class stocks in order to buy the more venturesome shares. This factor is apparent even in such securities as the best class of cable stocks. Easterns, Eastern Extensions, and Globe preference are amongst those which have yielded a trifle during the past week. United River Plate Telephones are 1-16 down, but on the other hand Chile Telephones hardened to 6¾. Marconi shares improved to 4¼ in the rush to buy the popular industrials, and other Marconi descriptions improved in sympathy.

To the man who is prepared to take risks, the shares of the Automatic Telephone Co. may be mentioned. They are, of course, frankly speculative, as everything else must be which is largely concerned with patent rights. That there must be some sort of automatic telephone in the near future is becoming apparent with the growth of the business, and probably it is only a matter of initial cost which causes the Government to hesitate before embarking upon the process at the present time. It is difficult to say what percentage of speculation and what of sound investment-possibility enter into the present price of Automatic Telephone shares, which is 31s. 6d., but for those who do not mind a speculation, fairly faced as such, the shares might be picked up in order to rest with others of higher class in the strong box which holds financial hostages for the future.

With the conclusion of the moulders' strike, a better tone has become apparent amongst engineering and kindred shares, but so far no marked advance has occurred. Babcock & Wilcox went up 3-16 last week, and are another 1-16 to the good now. British Aluminium gained a few pence. Siemens rallied to the extent of 2s. 6d., and are once more hard on the heels of 30s. India-Rubber shares at 17¼ look cheap in their ex dividend guise. Canadian General Electric closed its subscription lists for the new shares last Monday, on which day the rights changed hands at 3s. premium. Midland Electric 7 per cent. preference have gone back to 4¾. London United Tramways debenture at 40 is a couple of points lower. British Electric Traction has risen to 40¼.

Amongst foreigners, Anglo-Argentine Tramways have begun to recover; the first and second preference are both higher, and expectation once more fastens upon the hope that arrears of dividend on the former may be dealt with during the current year. British Columbia Electric stocks are harder, the preferred, with a rise of 2, being 7 up within a fortnight. Brazilian Tractions at 61 regained part of their loss. One of the features in the railway markets is the strength of Mexicans, the prices rising hand-over-fist. So far this has not been much reflected in the utility issues, but that these will follow in due course, provided Mexican Rails hold their improvement, may be regarded as fairly well assured. Mexican Light preferred is 5 points better. The rubber market is booming, attracting an enormous amount of trade from all over the country. Substantial rises have been secured by all the leading shares practically without exception, owing to the price of the raw material hardening to 2s. 10½d. per lb. It is a matter for doubt whether the boom has not been too rapid to last without some reaction occurring.

Edisons rose to 24s. on Tuesday afternoon, on a rumour that there may be something afoot between this company and the General Electric. The ordinary shares of the latter have hardened to 40s. bid.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend 1917.	Dividend 1918.	Price Jan. 6, 1920.	Rise or fall.	Yield p.c.
HOME ELECTRICITY COMPANIES.					
Brompton Ordinary	10	8	8½		£6 16 2
Charing Cross Ordinary	4	4	3	+ ½	6 13 4
do. do. do 4½ Pref.	4½	4½	3	—	8 3 6
Chelsea	5	3	3	—	5 0 0
City of London	8	8	12	—	6 13 4
do. do. 6 per cent. Pref.	6	6	9½	+ ½	6 6 4
County of London	7	7	9¾	+ ¼	7 9 4
do do. 6 per cent. Pref.	6	6	9½	+ ½	6 11 3
Kensington Ordinary	7	6	4½	—	6 6 4
London Electric	Nil	Nil	1½	—	
do. do. 6 per cent. Pref.	5	6	3½	—	8 17 10
Metropolitan	4	5	3	—	8 6 8
do. 4½ per cent. Pref.	4½	4½	3	—	7 10 0
St. James' and Pall Mall	9	10	6	—	8 6 8
South London	5	5	2¼	—	7 8 6
South Metropolitan Pref.	7	7	1	—	7 0 0
Westminster Ordinary	9	8	5½	—	7 12 5
TELEGRAPHS AND TELEPHONES.					
Anglo-Am. Tel. Pref.	6	6	90½	—	6 12 8
do. Def.	1½	83/6	22½	—	7 10 0
Chile Telephone	8	8	6¾	— ¼	6 5 6
Cuba Sub. Ord.	7	7	10½	—	*6 13 4
Eastern Extension	8	8	16	— ½	*5 0 0
Eastern Tel. Ord.	8	8	167½	—1	*4 15 7
Globe Tel. and T. Ord.	7	8	16¼	—	*4 19 3
do. do. Pref.	6	6	92	— ¼	6 3 1
Great Northern Tel.	22	22	23½	—	9 7 2
Indo-European	13	13	48¼	—	6 13 4
Marconi	20	25	4½	+ ¼	5 17 8
Oriental Telephone Ord.	15	10	2 5/16	—	4 14 1
United R. Plate Tel.	8	8	7 1/16	— 1/16	*5 5 10
West India and Panama	1/8	1/8	1 1/16	— 1/16	Nil
Western Telegraph	8	8	17xd	—	*4 14 2
HOME RAILS.					
Central London Ord. Assented	4	4	58½	—	6 16 9
Metropolitan	1	1½	26	+ ½	4 16 2
do. District	Nil	Nil	21½	+ ½	Nil
Underground Electric Ordinary	Nil	Nil	3	+ ⅛	Nil
do. do. "A"	Nil	Nil	7/9	+ 1/16	Nil
do. do. Income	4	5	87½	+½	*5 14 3
FOREIGN TRAMS, &c.					
Adelaide Sup. 6 per cent. Pref.	6	6	87	—	7 14 10
Anglo-Arg. Trams. First Pref.	5½	Nil	3½	— ⅛	—
do. do. 2nd Pref.	—	—	3½	+ ¼	—
do. do. 5 Deb.	5	5	61½	—	8 2 8
Brazil Tractions	—	—	61	+ ½	—
Bombay Electric Pref.	6	6	13½	—	4 9 0
British Columbia Elec. Ry. Pfce.	5	5	69½	+1	8 0 0
do. do. Preferrred	Nil	9½	56½	+2	4 8 9
do. do. Deferred	Nil	Nil	53½	—	Nil
do. do. Deb.	4½	4½	62½	+1½	6 16 0
Mexico Trams 5 per cent. Bonds	Nil	Nil	42½	—	Nil
do. 6 per cent. Bonds	Nil	Nil	20	—	Nil
Mexican Light Common	Nil	Nil	17½	—	Nil
do. Pref.	Nil	Nil	30	+5	Nil
do. 1st Bonds	Nil	Nil	53½	+1	—
MANUFACTURING COMPANIES.					
Babcock & Wilcox	15	15	3¾	+ 1/16	*4 12 2
British Aluminium Ord.	10	10	1 3/32	+ 3/32	5 12 3
British Insulated Ord.	25	12½	2	—	6 5 0
Callenders	25	25	8½	—	7 11 6
,, 6½ Pref.	5	6½	4 7/16xd	—	7 2 1
Castner Kellner	25	20	3 7/16xd	—	3 15 7
Crompton Ord.	7	10	21/6	—	9 6 0
Edison-Swan, "A"	—	10	1 7/16	—	8 8 0
do. do. 5 per cent. Deb.	4	5	79 1/16xd	—	6 5 9
Electric Construction	10	10	1 7/16	—	9 8 2
Gen. Elec. Pref.	6	6½	19/6xd	—	6 12 6
do. Ord.	10	10	40/-	—	*5 0 0
Henley	25	25	2½	—	5 11 1
do. 4½ Pref.	4½	4½	8½	+ ½	6 4 2
India-Rubber	10	10	17 1/32xd	—	*5 16 0
Met.-Vickers Pref.	—	—	2½	—	5 14 0
Siemens Ord.	—	10	29 6	+2/6	*6 15 7
Telegraph Con.	20	20	26½	+ ½	*4 10 6

* Dividends paid free of Income Tax.

AN ELECTRICALLY HEATED THEATRE.

THE heating of large buildings such as theatres, blocks of offices, or flats has always been a difficult and costly undertaking, and to-day it is not made any easier by the high price of coal, which is used for the systems of steam heating that are in vogue in most places. Such considerations, coupled with the fact that the old system proved very unsatisfactory, induced the management of the Lyric Theatre, Hammersmith, W., to install electrically-heated radiators. The system, which we

FIG. 1.—QUAIN 3-BAR FIRE.

were recently privileged to inspect, is, we believe, the first of its kind to be installed in any large building in this country; the London County Council authorities, whose regulations have been strictly complied with, are watching the experiment with a good deal of interest, as are also other London theatre managers and certain Yorkshire municipal authorities.

At the present time when the problems of heating in connection not only with housing schemes, but also with industrial heating, are receiving considerable attention, the results obtained with this installation should be of more than usual interest. On the occasion of our inspection the installation had been at work for some time, and it is gratifying to record that it has fulfilled all expectations with regard to reliability and efficiency.

Electrical heating was decided upon only after full consideration of other systems, and it has now displaced throughout the whole building the gas-heated radiators which were formerly used. It will probably come as a surprise to some readers that the installation of the electrical system was found to be 65 per cent. cheaper than a system of hot-water pipes to give the same results. Moreover, it has proved to be 50 per cent. cheaper to run than the displaced gas system. These figures are not estimated, but are based on several weeks' running costs, and further, the electricity supply, which is taken from the public supply mains, is not charged for at what might be termed a low rate.

The Quain Electric Co., Ltd., whose "Thermaglo" radiators have been installed throughout the theatre has during the past three years supplied electro-steam radiators in considerable numbers to the War Office and Admiralty for use in aircraft hangars, particularly where "lighter-than-air" machines are housed. The special advantage in this connection lies in the fact that the radiator is thoroughly "gas-tight," and thus altogether obviates the risks of fire and explosion always present where there is the possibility of inflammable fumes, gases, or articles reaching a flame or even a radiant-heated surface. Experience during the war period enables this claim to be made with justice.

The electro-steam radiator is particularly useful where warmth is required without radiant heat; it is self-contained, fire and fool proof, devoid of radiant surfaces, and its freedom from noxious fumes renders its use ideal from a hygienic standpoint for bedrooms and nurseries. In public buildings or conservatories, low-temperature heating by convection is desirable; it is obviously better than a system employing small high-temperature heaters which overheat patches of seating accommodation in their immediate vicinity.

Thermaglo radiators are suitable for either direct or alternating currents of any phase. The Quain heating element can be applied to every apparatus and process in which heat is utilised; it provides high temperatures, and maintains them at any given degree, up to 1,800 deg. C., without appreciable variation and with no risk of melting or fusing. The element consists of a resistance wire closely wound upon a hollow support of silica, which is itself enclosed within a silica casing. The apparatus burns equally well in a vacuum in or out of water, and being relatively small, compact, and simple in structure, it can be adapted for any purpose the user requires. For steam radiators its application ensures stability of temperature, and owing to the absence of super-heated surfaces it prevents vitiation of the atmosphere. High-grade nichrome alloy wire and specially-graded silica quartz glass are used in the element.

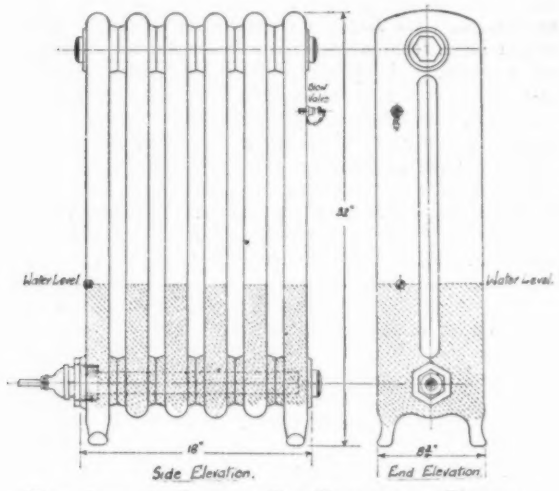
An example of the multi-bar fires installed in dressing rooms and offices is shown in fig 1. The number of these fires installed is seven, each with a consumption of 1,500 watts. The centre bar is controlled by the switch at the wall plug, while the other two are con-

FIG. 2.—THERMAGLO ELECTRO-STEAM RADIATOR.

trolled by the switch on fire itself. The glowing red-hot bars of quartz are pleasing to the eye, and make a room look cosy. The fires, it is claimed, give a real radiant heat with high thermal efficiency, and the added advantage that the element is protected from wear. The electro-steam radiator, fig. 2, is the type of which 30 are used throughout the main body of the Lyric Theatre, as well as in the corridors and on the stage,

placed either singly or in pairs. Formerly trouble was experienced with the draughts which originated at the main entrance to the theatre, and blew along the corridors. These have been entirely eliminated by placing two radiators against the wall immediately facing the swing entrance doors so that the air is warmed as it enters the building.

In figs. 3 and 4 are seen respectively the side and end elevations of the electro-steam radiator. Fig. 5 shows a complete 1-KW. heating unit, and fig. 6 the details of the gas-tight fitting and connections. The



FIGS. 3 AND 4.—SIDE AND END ELEVATION OF RADIATOR.

standard radiator, which weighs approximately 165 lb., is suitable for heating 1,000 to 1,200 cu. ft. of air space under average conditions, the radiating surface being 20 superficial feet and the loading 1,000 watts. Each radiator is fused separately, and they are all under the control of one person from one switchboard. They are on for six hours each day, the system being to switch them on at noon, off at 3 p.m., and on again from 6 to 9 p.m., which is found to be sufficient to heat the whole theatre to a comfortable temperature. We

FIG. 5.—HEATING ELEMENT.

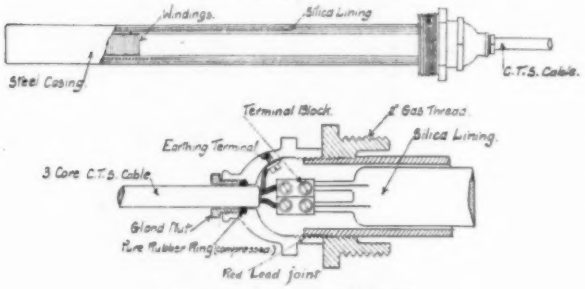


FIG. 6.—GAS-TIGHT FITTING.

understand that the system of ventilation is now receiving attention, and by certain improvements that are to be made it is expected that still more efficient results will be obtained from the heating system.

In conclusion, we have to thank Mr. A. P. Horne, business manager, for facilitating our inspection of the installation; Mr. Davies, electrician, who carried out the installation and explained its details; and Mr. J. R. Spink, who supplied drawings from which the above illustrations were reproduced.

Tradesmen Using the Royal Arms.—The *London Gazette* for January 2nd, contains lists of tradesmen in London and elsewhere, who hold warrants of appointment to Royalty, with authority to use the Royal Arms.

SCIENTIFIC MANAGEMENT: A SOLUTION OF THE CAPITAL AND LABOUR PROBLEM.

DISCUSSION AT GLASGOW.

AT Glasgow, on December 9th, Capt. J. M. Scott-Maxwell's paper, an abstract of which appeared in our issues of December 19th and 26th, was read and discussed before the SCOTTISH CENTRE of the INSTITUTION OF ELECTRICAL ENGINEERS.

Mr. A. PAGE agreed that any system which would increase efficiency and eliminate waste was likely to meet with approval, providing it was accompanied by raising the status of the worker. But how were they to get rid of the suspicion of the unions which led to so much friction and was the main cause of limitation of output? Until that was accomplished, any attempt at motion and time study would be futile. The gaining and retention of the goodwill of the worker was the essence of successful management. There was increasing evidence of a more sympathetic attitude on the part of the employing class, and there was promise in the activities of the Joint Industrial Councils. The scientific handling of labour was the most difficult part of Dr. Taylor's system, and a great deal of spade work would require to be done before the British workman would agree to make an automaton of himself in return for the satisfaction of knowing that he had completed his job with the minimum of effort.

Mr. J. H. BUNTING said they should now be convinced that scientific management was the best, if not the only way, to increase production in this country. He saw no reason why the principles of scientific management should not be introduced into the factories of this country, not necessarily in the form in which it was introduced by Dr. Taylor. He thought, however, that they would have to do something for themselves before asking Government support. He had seen the principle introduced in a modified form, and it was attended by remarkable results. If, however, it was introduced at present they were likely to have the trade unions up against them. The employer needed as much education in this respect as did the worker. Any person who seriously considered the paper would improve his business.

Mr. MORRISON pointed out that they would have to convince the workers that the idea was not to give something for nothing; if higher wages had to be paid they must have increased output. If employers did not get a move on the workers would step in, force their hands, and introduce the principle for themselves.

Mr. T. C. HERBERT said he had for long been convinced that scientific management was the panacea for most of their industrial ills. Strongly as the author had put the human aspect of the problem he had not put it strongly enough. He would have liked it emphasised that the whole basic idea of scientific management was the substitution of help and assistance by the functional foremen for the mere bullying and driving of the ordinary general foreman. The mere fact that encouragement and help took the place of vindictive criticism and punishment must necessarily improve the relations between capital and labour. It was, of course, true that scientific management detached and eliminated false effort and secured efficiency in avoiding waste in both materials and human energy, but its foundation was, he suggested, an alteration in the attitude of the employer to the employed. Much of their difficulty the author rightly ascribed to the sheer ignorance of the so-called business man who often was neither an engineer nor an accountant, but virtually a stock exchange trickster. Such a man often failed to realise the sanctity of human life, and had not even discovered that to wear a man out was bad economics if only because it took time and money to train his successor. Such a man often failed to realise the utter idiocy of reducing a piece rate once fixed. However, the author had perhaps done full justice to this aspect of scientific management. The conversion of the labour leaders to his views was a task which he trusted the author would soon see accomplished.

Mr. JAMES RICHARDSON said all agreed with the first principle of scientific management proposals. It appeared to him that they were likely in the course of the next few years to be faced with a crises which could only be met by adopting the principles advocated by the author. As to the application of the principles, they had not staff officers on hand able to apply them, and were looking to the universities and technical colleges to meet the defect.

Mr. L. M. JOCKEL expressed his conviction that scientific management would come. In the meantime much could be done on the elemental side of the question, say in the introduction of simple elementary reforms which led to economy and improved results.

Mr. W. KEOCHIE pointed out that certain factories were largely run under scientific management, but they had not adopted the title because of its cold-blooded suggestiveness. The system where tried was working satisfactorily, but the proper spirit had to accompany its introduction. If the men were treated in a humane fashion the best results would follow—the application of the system might also get over the bogey of shorter hours and higher wages.

Capt. J. M. SCOTT-MAXWELL, briefly replying, explained that he did not mean that they should wait for the formation of National Boards before applying the system, but if each made an effort they must have some national or central organi-

sation. Meanwhile, they ought to start national propaganda. He agreed that in many cases employers were worse than the workers. That was what brought scientific management into disrepute in America. By the proper operation of scientific management they not only made more profits, but shortened hours and raised wages as well. The system had been referred to as cold-blooded in its suggestiveness, and he had heard it termed murderous. Taylor was not that sort of fellow. He had great concern for his workers, and in the Taylor factories, where the system had been a success, harmonious relations prevailed. He would have emphasised the "good to humanity" potentialities of the system had he been addressing trade unionists or socialists, but it was the employers he wished to get at now. The system taught the men; it did not drive them, and the provision of instructors formed a valuable link between the two sections. As the Employers' Federation had to deal with labour, that body would have to be tackled first. Staff training in the principles of scientific management took five years in America. It was special training, and they were not likely to secure it if the matter was introduced in piecemeal fashion in different workshops. It was more likely to come by national propaganda. The idea that because scientific management had had a bad record in America it would be bad here was a mistake. It was possible that a bad employer might use the system to the detriment of the employés, but there was nothing to show that the system was bad in itself. Scientific management was simply a system for measuring human effort.

Discussion at Birmingham.

At Birmingham, on December 17th, the paper was read and discussed before the SOUTH-MIDLAND SECTION of the Institution.

Mr. A. PHILLIPS said he was a firm believer in the application of scientific management as a means of obtaining increase in production. Time study, the fixing of rates, and the elimination of all unnecessary motions in the performance of work, would go a long way to reduce the cost of production; but Taylor scarcely visualised the conditions that were bound to obtain under what was recognised at the present time as "mass production," and this would require very careful consideration on the part of manufacturers who must apply it. The number of skilled workers, instead of being less would be greater; they would, however, be engaged in producing the necessary equipment for the unskilled workers. The amount of production would then be increased by hundreds per cent. The field of unskilled workers would necessarily be leavened by many who would have attempted, but failed, to reach the amount of skill requisite for the more skilled occupations; also from the ranks of the unskilled operators on machines would undoubtedly arise (as well as from the ranks of skilled labour) men who would fill high administrative positions in the works. He believed that it was quite reasonable to have a condition in which people would carry out the purely mechanical repetition part of production, and need not necessarily regard their work as their whole life, but merely as a means of providing them with the necessaries of life. Shorter hours, congenial conditions of labour, in so far as the sanitary and hygienic arrangements of the establishments in which they had to work were concerned, would, he believed, render those who worked under such conditions happier, realising that they might enjoy and live a more full and happy life in their leisure time, which would be much greater than it had been hitherto. That it would be necessary to subject themselves to a certain amount of discipline they would readily agree to when they realised the great advantages that, not only they but the community at large, would derive from this method of intensive production. The requisite thing at the moment was to educate the people to realise the necessity of this condition. He saw no reason why the great majority of those who were doing preparatory work to equip themselves for higher positions in other spheres of industry, should not devote a part of their time to attending to the world's productive machinery, thereby directly benefiting themselves and also the community. While payment by results was what they were all anxious to get, yet payment by piece work was not always the most satisfactory method. What was needed was a balanced number of parts, and this result was best attained by careful calculation of the number of pieces one could get with safety from any given machine. The great difference between this method and the system of individual piece work was that although payments were made by results, the results were predetermined, and not left to the initiative of the individual.

Mr. C. BELL-WALKER referred to that aspect of the question bearing upon labour unrest, and was of opinion that the cause was mainly psychological; increased pay and efficiency would not cure, but might possibly aggravate it. The best work was rarely performed with the object of making money, but arose from a pride and interest in it. A large proportion of the nation endured unparalleled suffering and privation during the war for practically no pay, and no financial inducement would have so stimulated them. The danger of the Taylor system was the tendency to reduce men to the level of parts of machines. A piece-work system of payment, although at present the most successful and practicable, was not the system that should be aimed at, because the worker's and employer's material interests were antagonistic, the former's being to do the least amount of work for the greatest amount of money, and the latter's to give the least money for the greatest amount of work. It had never been proved that high wages in themselves were a cure for labour unrest.

Mr. J. A. HANNAY stated that management could not be called scientific if any difference was allowed to come between capital and labour. It was absolutely essential to approach these matters from a broader and national standpoint. He hoped the author was not going to make the mistake of holding out a promise of a speedy solution of the capital and labour problem by scientific management. It would take a great many years to solve the difficulty, but scientific management would undoubtedly play a very great part in the solution. The author had omitted to mention the essential matter of education and training of young men who were preparing to enter into various industries. He, the speaker, considered that present educational means were totally inadequate, and before they could expect to have really scientific management many schools and training colleges would have to be overhauled and restaffed. He considered it a scandal that the teaching profession was not better supported and the very best possible men selected. In the future scientific management in the engineering industry would have to devote more and more attention to tool room, jig and tool design, and equipment, and there should not be the slightest cause for anxiety on the part of the workmen in developing improvements to the greatest possible extent; this would be where they would eventually find nearly all their skilled men. The want of an adequate supply of skilled men was preventing tool rooms from being thoroughly developed, with a consequent loss of a very large amount of production. He emphasised the fact that if capital and labour could only agree and concentrate more and more on tool equipment that would automatically solve innumerable problems. With regard to the workers' objection to repetition work as being uninteresting, he did not think there was anything to fear, providing the worker was adequately recompensed, and able to work under healthy conditions.

Lieutenant H. SOPER said, with regard to the suggestion that an industrial research organisation should be set up on national lines, that practice had proved that in individual works the installation of scientific management was best carried out by starting with a small section and using that as an object lesson to convert other sections, until the whole had been converted. In view of the distrust with which scientific management was at present viewed by uninformed employers and employed, he suggested that if the Government were to take up the work it should commence with a number of model factories at which both employers and trade union representatives could familiarise themselves with the subject.

Mr. N. MARTIN regarded the researches of Taylor as an attempt to set up standards of measurement for that most elusive of all quantities, human activity, and he regarded his work as the opening of a new era in industrial history, when instead of being content with a rough quantitative idea of the amount of human activity, based on financial results an exact quantitative analysis could be made beforehand of the amount of activity required to produce a definite result by standard methods. From what he had seen of the Black Country a very large proportion of the workers were employed in repetition work, in which no rational human being could be permanently interested. They worked not for the intrinsic interest of the work, but to earn their daily bread. It was in such cases that Dr. Taylor's work offered to the worker, without increasing the monotony of his work, a greater reward for his labour.

Mr. W. H. EDWARDS said that scientific management had for a long period been used and improved upon by firms in this country, but there were hundreds of factories where no system was used, while in some instances various systems were used, even in the same factory, one department being up to date, and another using ancient methods. An important matter was the education of the skilled man for such positions as manager, supervisor, foreman, designer, and toolmaker. Many boys who had a technical school training found it difficult to get into large works unless they were satisfied to be dumped on a repetition machine and their efforts stultified; manufacturers and others should offer facilities to such students.

The Magneto Industry in France.—As in Great Britain, there has been a great development of the magneto manufacturing industry in France since the commencement of the war. At the commencement of hostilities, it is estimated that the annual requirements in France in the way of ignition magnetos amounted to 7,500 machines, fully 90 per cent. of which were supplied from Germany. To meet war-time requirements, several old-established firms, as well as a number of new undertakings, undertook the manufacture of magnetos, and eventually, both as regards output and quality, the home manufacturers were able to meet the whole of the French needs, the production rising to 1,500 magnetos per month. Efforts are being made to maintain the position thus attained, and in addition to meeting the orders for magnetos from French motor-car manufacturers, an export trade in the machines is now being developed.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The Mira Igniter.

A British-made ignition unit, as an alternative to the magneto, and utilising energy from the starting and lighting equipment of the car, has been placed upon the market by the HIGH TENSION Co., of Belvedere Road, Westminster, London. The unit, fig. 1, of which Mr. M. A. Codd is the inventor, consists of a transformer coil of coarse and fine wire suitably insulated, mounted on a rotating shaft complete with condenser and contact breaker similar to that used in magnetos. The whole apparatus and connections are simple and strongly made. The transformer, with its contact breaker, is rotated by the engine within an insulating distributor body carrying the necessary number of terminals. The top of the distributor body carries a cover, which contains a cam ring, having the necessary number of cams to depress the contact-breaker spring according to the number of cylinders to be fired. Projecting from the insulating body of the transformer is a distributor comb, which passes the spark from the transformer to the heads of the terminals in the distributor leading to the plugs. There is a spark gap of about 1/64th in. in each case. The base of the distributor carries a tubular bearing, which extends within the transformer and round its driving shaft, terminating in a ball thrust bearing located below the contact-breaker plate. The contact-breaker cover carries the spring-loaded contact brush, which bears on the live stud in the centre of the contact-breaker plate, whereby the current from the accumulators is led to the transformer, by which it is raised to a voltage

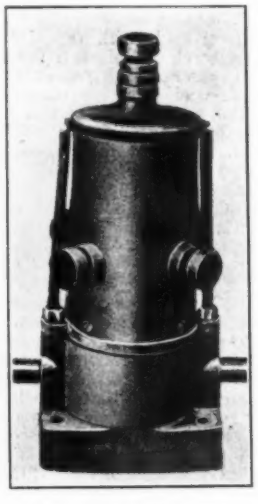


FIG. 1.—MIRA IGNITER.

sufficient to enable it to jump the gap at the plug points and leaves the transformer by way of the distributor comb. The appliance is interchangeable with most modern magnetos, and is fixed to the bedplate in the usual manner, the igniter shaft being connected up to the engine through a flexible coupling. It is claimed for the "Mira" that it gives equal results to a magneto at high speeds, and is far better at low speeds for the reason that the energy of the spark does not fall off as the engine speed decreases. The effect of the spark gaps between the distributor comb and the terminals, it is claimed, is that greasy or sooty plugs are rendered more positive in action owing to certain high-frequency phenomena. Easy starting is a main feature of the device, and is of importance when using starters, as the strain on the battery is thereby reduced. The igniter does not give increased output of spark energy with increased speed; parts that may require renewal are readily accessible, and it is claimed to be water and damp proof, and the ignition can be advanced or retarded as required.

A New Railway and Tramway Station Indicator.

Anything that can be done to afford relief to the serious overcrowding of underground railways and tramways will be greatly appreciated. It is held that the overcrowding is at least to some extent due to the fact that a large proportion of the passengers are not sure of the order of the stations, and are, therefore, not prepared to alight promptly when the train draws up at the platform at the station where they want to get out. Such a condition causes confusion amongst passengers attempting to board the train and those alighting, which in turn delays the departure of the train, and may very easily lead to trains running on a short headway "piling up" quickly. To overcome these difficulties an illuminated indicator, which we had an opportunity of inspecting recently, has been designed by MESSRS. INDICATORS, LTD., of 11, Southampton Row, London, W.C.1, and is, we understand, to be installed shortly, first on the Great Northern to Moorgate Street tube, and then will be extended to the Inner Circle and the Metropolitan system generally. The device is also applicable to tramway working where information concerning fares, &c., can be given as well as the stopping places and other matters of interest, and it is to be tried as an experiment on the Highbury to Westminster L.C.C. tramway route. The indicator, which forms the subject of several patents, can be made to any size for any number of stations; the device is controlled from a master switchboard in the driver's cabin, it is set at the start of the journey, and as soon as the train starts it works automatically. Its most ingenious feature seems to be the system of wiring; this forms the subject of a separate patent, and no matter how long the train is or how large the number of stations on the journey, it is only necessary to run four wires from coach to coach. Essentially the device consists of a long box, part of which is shown in fig. 2, which is divided into the same number of compartments as there are stations on the line. A glass panel fronts each compartment on which is engraved the name of a station, a small map, and other information regarding shops, theatres, &c., in the district served by the station. Behind each panel electric lamps are fitted which enable it to be illuminated. As the train leaves a particular station the panel for the next station at which the train will stop is lit up, all the others remaining dark, so that the passenger has early visual

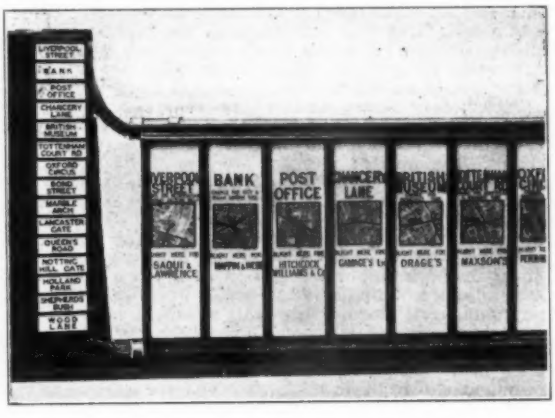


FIG. 2.—RAILWAY STATION INDICATOR.

indication of the station which is being approached, and he can, therefore, make his preparations to alight accordingly. As the train commences to slow up, a blinker light placed in a prominent position comes into operation as an additional warning. If certain stations are missed, the panels for such stations remain in darkness, the words "Not stopping at" appearing above them, but at the same time the panel for the next station stopped at is illuminated. The operation of the system is simple; a stop is provided at the side of the track near each station, which engages a projecting pivoted arm carried by the moving vehicle. The arm is slotted to receive a pin fixed to a vertical bar in such a manner that the impact causes the bar to rise. The latter, sliding in guides, is provided with collars which compress a spring, which in turn returns the arm to its normal position when the lever has passed over the stop. As the bar rises it makes contact with a switch arm, and thus closes the circuit on a solenoid which operates the arm of a step-by-step mechanism, causing it to move forward through one step. The energy for this circuit is obtained from a battery or other suitable source. When the core of the solenoid reaches its uppermost position, a second solenoid is energised, which releases the switch arm, allowing it to fall into its normal position, the solenoid is thus de-energised and the device becomes ready for the next impulse. The whole mechanism is so interlocked that each step must be completed correctly before the next step in the sequence of operation is commenced. The solenoid and lever mechanism is in duplicate, one set being used when the train is moving forward and the other when it is reversed. This ensures that the step-by-step switch is not thrown out of gear when the train is shunted. As an extra precaution the whole mechanism can be thrown out of gear when required. An ingenious arrangement is employed to overcome

the difficulty encountered owing to certain trains not stopping at all stations. A special switch for each station is fitted in the driver's cab, which on being closed connects the stop on the rotary switch corresponding to the stations which are to be missed to the next stop in the series. In conclusion, we have to thank Mr. Paul H. Waller, director, for placing at our disposal the illustration and the particulars set out above, describing a device which enables a train or tramcar to tell the story of its own movements from station to station. The passenger has only to glance at it to be sure whether the train stops at his particular destination, and it also warns him as to the next station ahead.

An Electric Motor Cycle.

A new electrically-driven combination motor-cycle and side-car has recently been seen on the streets at Ipswich. The machine in question, we understand, was built at the Orwell Works of Messrs. Ransomes, Sims & Jefferies, Ltd., to the specification of Mr. P. A. G. Mossay. The parts employed in its construction are described as having been merely assembled and not specially made for the purpose; if a suitable frame and motor were specially designed it could be much improved. Even in its present form the cycle is credited with travelling 30 miles on one charge of the battery, which is accommodated under the seat of the side-car, under favourable conditions and on good flat roads. The advantages of such a machine include extreme simplicity of control, noiselessness, and the absence of objectionable fumes and fire risk. Its speed is about 12 M.P.H., but it will mount hills even with the low-powered motor that is used, and the machine has been running for three months quite satisfactorily. The running cost is another point in favour of the machine. With power supply at 2d. per unit, a full charge of the battery, representing a distance of 30 miles, would cost 6d., which would give 0.2d. per car-mile as the cost of fuel, whereas with petrol at 3s. per gallon the cost would be 6d. There is no doubt a field of usefulness for an electric cycle car for town work.

TRADE STATISTICS OF CANADA.

THE following figures, showing the imports into and exports from Canada of electrical and similar materials during the year ended March 31st, 1918, are taken from the recently-issued trade statistics. Figures for the year 1913-14, being the last normal year of trade, are given for purposes of comparison, and notes of any increases or decreases have been added. The 1916-17 figures were published on p. 596 of our issue of December 20th, 1918.

IMPORTS.

	1913-4 Dols.	1917-8 Dols.	Inc. or Dec. Dols.
Copper wire, plain, tinned, or plated.—			
From United States ...	115,000	23,000	– 92,000
Electric light carbons and carbon points.—			
From United States ...	39,000	51,000	+ 12,000
,, Other countries ...	50,000*	—	– 50,000
Total ...	89,000	51,000	– 38,000
* Germany $40,000.			
Incandescent lamp bulbs, &c.—			
From France	2,000	1,000	– 1,000
,, United States ...	110,000	223,000	+ 113,000
,, Other countries ...	20,000*	10,000	– 10,000
Total ...	132,000	234,000	– 102,000
* Austria-Hungary $14,000.			
Electrical apparatus not mentioned (insulators, batteries, telegraph and telephone instruments).—			
From United Kingdom	809,000	93,000	– 716,000
,, France	29,000	4,000	– 25,000
,, Japan	—	10,000	+ 10,000
,, Sweden	80,000	2,000	– 78,000
,, Switzerland ...	3,000	—	– 3,000
,, Italy	5,000	—	– 5,000
,, United States ...	5,515,000	8,091,000	+ 2,576,000
,, Other countries ...	156,000	—	– 156,000
Total ...	6,597,000	8,200,000	– 1,603,000
Petrol engines.—			
From United Kingdom	111,000	5,000	– 106,000
,, United States ...	2,457,000	6,661,000	+ 4,204,000
,, Other countries ...	2,000	—	– 2,000
Total ...	2,570,000	6,666,000	+ 4,096,000
Steam engines.—			
From United Kingdom	50,000	1,000	– 49,000
,, United States ...	386,000	339,000	– 47,000
,, Italy	19,000	—	– 19,000
Total ...	**455,000**	**340,000**	**– 115,000**
Steam boilers.—			
From United Kingdom	112,000	15,000	– 97,000
,, United States ...	273,000	237,000	– 36,000
,, Sweden	—	12,000	+ 12,000
Total ...	385,000	264,000	– 121,000
Manufactures of india-rubber and gutta-percha (except tires, clothing, and similar goods).—			
From United Kingdom	231,000	179,000	– 52,000
,, France	9,000	1,000	– 8,000
,, Japan	—	11,000	+ 11,000
,, United States ...	776,000	881,000	+ 105,000
,, Other countries ...	81,000	—	– 81,000
Total ...	1,097,000	1,072,000	– 25,000
Electric motors, generators, and dynamos.—			
From United Kingdom	136,000	22,000	– 114,000
,, Sweden	103,000	2,000	– 101,000
,, United States ...	1,542,000	1,894,000	+ 352,000
,, Other countries ...	26,000*	—	– 26,000
Total ...	1,807,000	1,918,000	+ 111,000
* Germany $14,000.			
All machinery not mentioned, except sewing machines, textile machinery, printing machinery, &c.—			
From United Kingdom	1,702,000	274,000	– 1,428,000
,, France	79,000	—	– 79,000
,, Switzerland ...	49,000	—	– 49,000
,, United States ...	12,811,000	14,649,000	+ 1,838,000
,, Other countries ...	181,000*	21,000	– 160,000
Total ...	14,822,000	14,944,000	+ 122,000
* Austria-Hungary $8,000.			
Lighting fixtures of metal (including electric).—			
From United Kingdom	31,000	4,000	– 27,000
,, France	8,000	8,000	—
,, United States ...	637,000	432,000	– 205,000
,, Japan	1,000	12,000	+ 11,000
,, Other countries ...	28,000*	—	– 28,000
Total ...	705,000	456,000	– 249,000
* Germany $14,000.			
Iron and steel wire, single or stranded, covered with cotton, linen, silk, rubber or other material, including cables so covered.—			
From United Kingdom	304,000	1,000	– 303,000
,, United States ...	563,000	234,000	– 329,000
,, Other countries ...	11,000	—	– 11,000
Total ...	878,000	235,000	– 643,000

Mica.— EXPORTS.

To United Kingdom ...	36,000	6,000	– 30,000
,, United States ...	156,000	451,000	+ 295,000
,, Other countries ...	17,000*	—	– 17,000
Total ...	209,000	457,000	+ 248,000
* Germany $13,000.			
Electrical apparatus.—			
To United Kingdom ...	25,000	119,000	+ 94,000
,, Newfoundland ...	9,000	35,000	+ 26,000
,, United States ...	67,000	452,000	+ 385,000
,, France	3,000	1,068,000	+ 1,065,000
,, Spain	—	19,000	+ 19,000
,, Other countries ...	3,000	474,000	+ 471,000
Total ...	107,000	2,167,000	+ 2,060,000
Machinery (other than threshing, linotype, washing, and sewing machines).—			
To United Kingdom ...	48,000	897,000	+ 849,000
,, Newfoundland ...	56,000	111,000	+ 55,000
,, New Zealand ...	9,000	6,000	– 3,000
,, Argentina	9,000	5,000	– 4,000
,, France	21,000	86,000	+ 65,000
,, United States ...	195,000	1,549,000	+ 1,354,000
,, Russia	—	34,000	+ 34,000
,, Australia	41,000	12,000	– 29,000
,, Spain	—	4,000	+ 4,000
,, Other countries ...	27,000	218,000*	+ 191,000
Total ...	406,000	2,922,000	+ 2,516,000
* Japan $121,000. India $19,000.			
Petrol engines.—			
To United Kingdom ...	—	8,000	+ 8,000
,, Newfoundland ...	73,000	149,000	+ 76,000
,, United States ...	12,000	11,000	– 1,000
,, Other countries ...	3,000	4,000	+ 1,000
Total ...	**88,000**	**172,000**	**+ 84,000**

ELECTRICITY IN TIN MINING.

By D. M. W. HUTCHISON, B.Sc., M.I.E.E., and W. J. WAYTE, A.M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE Federated Malay States furnish the product known in the metal market as "Straits tin"; the exports in 1913, the last normal year, were 50,127 tons of metal, value approximately £9,800,000. The labour force employed in tin mining in the same year numbered 225,000, 216,000 of this number being Chinese, but the adoption of machinery and other causes have resulted in recent years in a large decrease in the number employed. Machinery, which is already used to a large extent, is likely to come into use much more in the near future.

Mines under Chinese management in 1918 produced about 70 per cent. of the total output, and as there are less than half a dozen electrically-driven Chinese mining plants there should be great scope for the electrical engineer in the immediate future.

In 1917, 7,600 kilowatts of generating plant and 8,300 horse-power of motors were installed on tin mines, but the majority of mines where power is employed still use steam, generally in a very wasteful fashion.

The increase in the cost of firewood owing to its scarcity, the discovery in recent years of a valuable deposit of coal in Selangor suitable for burning on mechanical grates, and the necessity that now exists for working low-grade propositions on a large scale, are three factors which are bound in the near future to result in the installation of up-to-date economical power plants for mine working.

The pre-war rate of pay for Chinese labour was 60 cents (1s. 5d.) a day; it is now about 80 cents (1s. 10½d.).

Men in charge of electrical machinery have by law to possess certificates of competency issued by the Examining Board under the Electricity Enactment. This law extends to European engineers, who, however, if associate members of this Institution, are not called upon to appear before the Board.

The rate of pay varies greatly with the individual, especially in the higher grades, but the following are approximate rates paid in Perak:—

2nd grade chargemen $24 per month (£2 6s. 11d.).
1st grade chargemen $40 to $75 (£4 13s. 9d. to £8 15s. 8d.).
2nd grade engineer $120 to $200 (£13 11s. 2d. to £23 8s. 8d.).
1st grade engineer $350 to $450 (£39 to £50 14s. 7d.).

OPEN CAST MINING.

A typical large open cast mine in full working consists of one or more huge oblong pits in the ground, perhaps 80 feet deep and many acres in extent. At one end of each pit will be an incline consisting of a double line of rails up which the ore is hauled to the puddler station; in another position a similar incline for the removal of overburden, which is dumped out of the way, into an old working for preference.

The puddler station is furnished with rails and a double-drum winch which serves to haul up the full trucks and lower the empty ones.

The karang (ore) is dumped into the puddler, mixed with water and churned, the mixture being led to sluice boxes through a coarse screen.

The sluice box consists of two or three compartments 200 feet or so long, furnished with removable slats across the bottom which catch the heavier tin particles and allow the lighter sand and slimes to escape to the tailings dump.

The chief uses for power are for hauling, pumping (both for unwatering the mine and for supplying water for the puddlers and sluice boxes), and for puddler driving and lighting the mine at night.

The question of generating on a large scale in central stations and distributing to mines has been discussed many times, most recently by a Commission appointed to inquire into various questions connected with tin mining. The authors do not consider that the prospects of a power company would be very rosy.

A co-operative power station to supply a group of well-proved mines is a different proposition altogether and seems to be the solution of the problem.

HYDRAULIC MINING.

In hydraulic mining proper the ground is cut by jets of water projected by monitors under a natural head of from 50 to 400 ft., and the mixture if necessary elevated by hydraulic elevators to the sluice boxes where the treatment follows the procedure outlined under open cast mining. The hydraulic method is used on some of the largest properties in the country.

Where economy in the use of water is necessary, or where the ratio of head to lift is less than about 5 to 1, making the economical use of elevators out of the question, or where the total head would be unnecessarily high for the monitors, it is usual to install gravel pumps and to use part of the available head for generating electricity to drive these pumps, the remainder being used for the monitors.

The gravel pump is a centrifugal pump of special make provided with renewable liner and wearing plates, capable of raising any stone which can enter its open-ended suction pipe. Its efficiency is naturally not high; the combined efficiency of pump and motor works out at about 42 per cent., the mixture pumped being about 5 per cent. solid by bulk.

As an average the efficiency of pump and pipe work may be taken at about 38 per cent., as against 16.6 per cent. for the elevator.

A suction dredge consists of a centrifugal pump to supply a monitor jet, together with a gravel pump to elevate the mixture.

Given a certain water power, 28 per cent. more work can be done by employing the water power to generate electricity to drive gravel pumps than by using it for elevators.

The pump works with a shallow open sump and a suction lift of 15 ft. or so as a rule, and delicate speed regulation is necessary to keep the water level in the sump constant.

As three-phase current is generally used owing to convenience in distribution, it is the usual practice to drive the pumps by induction motors and to regulate the speed by rotor resistances. In some cases the motors are run at full speed and throttling pieces put in the delivery pipe, which has the effect of introducing artificial head, thus cutting down the delivery. Both these methods are, of course, wasteful, but it is probable that they will continue in use in preference to the use of direct current.

In the divided-volume system the cutting is done by jets of water under natural head directed on to the working face by monitors, the size of the jet being usually about 2 in. diameter.

The whole of the available pressure water is piped to the mine and there utilised partly to supply monitors and partly to generate electricity for the purpose of driving gravel pumps to elevate the mixture cut by monitors.

The extra amount of water available for cutting, and consequently the extra ground cut by substituting gravel pumps for elevators, is considerable.

The gravel pump is capable of a maximum lift of about 100 ft., although it loses efficiency, except in the largest sizes, at lifts much over 70 ft.; but pumping in two lifts by gravel pumps, where necessary, is hardly less efficient than pumping in one, whereas to use elevators in two lifts is an exceedingly inefficient process.

It is the usual practice where a high fall is available to use the first part of the fall for generating electricity, which is transmitted to the mine for driving gravel pumps. The remainder of the fall is used for monitors, and as of course all the water which passes the Pelton wheels in the electric power station goes on to the monitors, this may be called the divided-head system.

BUCKET DREDGING.

Bucket dredging is a form of alluvial mining which has become very popular in the Federated Malay States during the last few years, and will doubtless become more so, as the richer and more easily worked alluvial deposits become exhausted. By this means, low-lying tin-bearing land of low grade can be worked at a profit which would not be practicable by any other method.

At the present time 17 dredges are operating in the F.M.S., only one of which is driven electrically, so that with a cheap supply of power tin dredging should open a wide field to the electrical engineer. The best values are usually on limestone, so that the dredge and machinery must be of very robust construction to withstand the severe shocks which are of frequent occurrence.

TYPICAL INSTALLATIONS.

The most modern example of hydraulic-electric mining in the Federated Malay States is the Batu Karang mine of the Idris Hydraulic Tin Co., Ltd., which is worked entirely by gravel pumps driven electrically, the power for generating current and cutting purposes being obtained from water on the "divided-head" system.

The pipe line to the power house is 81 chains long and is designed to carry 400 to 450 cu. ft. of water per minute, the gross head being 955 ft. and the effective head 935 ft. The diameter of the pipe varies from 21 in. to 16 in.

The plant installed consists of two Pelton wheels, each of 700 B.H.P., 750 R.P.M., with governors of the oil-pressure type fitted with hydraulic automatic servo-motors operating combined needle nozzles and deflectors. These drive through flexible couplings two alternators, each of 450 KW., three-phase, 50 periods, 400 volts, with the exciter overhung on an extension of the alternator shaft.

A bank of three single-phase transformers raises the pressure to 3,000 volts for transmission.

The transmission line is 1½ miles in length and consists of bare copper wire, with an earth wire. The poles are of steel with cast-iron bases and buckled plates. The lightning

arresters at each end of the line are of the horn type with powdered carbon "Brazil" resistances. These arresters in conjunction with the earth wire have been found to give good protection against lightning.

The water after leaving the Pelton wheels is discharged into the intake of the lower pipe line outside the power station.

The pipe line is 1¼ miles in length, 16 in. in diameter, and a pressure of 170 lb. per sq. in. is obtained at the bottom of the mine where the water is used for cutting purposes with monitors.

The sub-station contains one bank of single-phase step-down oil-cooled transformers, each of 125 K.V.A. rating, 1,600/230 volts connected star-star, and one bank of single-phase transformers as above, but of 50 K.V.A. rating. The neutral point of each group of transformers is earthed through a resistance.

The total height from the bed-rock to the sluice box varies from 70 to 90 ft., and a double-stage system of working is arranged with gravel pumps. The larger gravel-pump motors are all provided with liquid controllers connected in the rotor circuit and capable of reducing the speed 50 per cent. continuously if required.

The Idris Mine is equipped throughout with electrical machinery of British manufacture.

At the French Kampar Mine most of the property is being worked on the suction dredge system. Power is generated in two stations, the original hydro-electric plant consisting of two horizontal radial outward flow turbines working under the unusually high head for this class of machine of 1,312 ft.

The Diesel station, which is quite close to the hydro-electric plant, houses a Diesel engine driving a 400-KW. alternator.

The total capacity of the two plants in parallel is 744 KW., but for ordinary running the Diesel is looked upon as a stand-by to the water power which is apt to run short at times. The pressure is 6,000 volts, three-phase, with insulated neutral.

Kampar is a town situated at the foot of a large range of mountains, and it experiences lightning storms of remarkable severity, hence the lightning arrester gear deserves attention.

At the power house end the gear is housed in a separate building, and comprises horn-gaps and water leaks. The former have a break of 5 mm. and a resistance consisting of a column of alkaline electrolyte contained in two open-ended earthenware tubes provided with electrodes. The water leaks are of the enclosed type consisting of two glass tubes in parallel, 800 mm. long and 14 mm. internal diameter, connected between each phase and earth. A continuous circulation of water is maintained through the tubes. Flat choke coils are placed in the power house.

At the sub-stations, horn-gaps with 7-mm. openings under cover with flat choke coils are installed on the high-tension side, the transformer neutrals being earthed on the secondary side.

This arrester gear gives good results except in heavy storms, when it is considered advisable to shut down. At the mine gravel and nozzle pumps are installed.

The Lahat Mines, Ltd., are a good example of open-cast working, the depth at the present time being 145 ft., but bores have been sunk to a depth of 250 ft. from the surface and the bedrock has not been reached.

The karang is raised to the puddlers in trucks up two inclines 600 ft. long, each served by a 40-B.H.P. electric winch. Power is also used for pumps and puddlers, energy being purchased from another mine.

The Tin Bentong Mine is being worked by an electrically-driven bucket dredge. Power is generated by a hydro-electric plant and transmitted 4¼ miles to Bentong at 11,000 volts.

A unique feature of the installation is the use of water containing an abnormal amount of sand in suspension.

There is naturally a considerable amount of wear of nozzles, needles, and buckets, but the fact remains that the presence of considerable amounts of solid matter in water does not prevent its use with moderate spouting velocities.

The lightning arresters in the power house and sub-station are of the aluminium-cell type surmounted as usual with spark gap and charging device. Between each line and earth and between line and line there are two cells in series. This arrangement has worked well.

The connection from the shore to the dredge is made by a three-core cable. The cores are insulated with vulcanised india-rubber, laid together, and wrapped overall with five laps of varnished cambric; the cable is then served with compounded jute and armoured with galvanised iron wire. The weight of the cable is taken by barrels floating in the dredge paddock.

LOCAL CONDITIONS.

The authors draw attention to certain details in the specification of machinery which, often disregarded entirely, are of vital importance.

The climate of the Malay Peninsula is moist and hot, the shade temperature rarely exceeding 90 deg. F. The rainfall varies from 90 to 130 in. for the year.

It is not advisable to generate at a higher pressure than 2,200 volts, owing to the rapid deterioration of insulating materials due to the moisture-laden atmosphere.

For transmission so far 11,000 volts is the highest pressure in use. For higher voltages special precautions would probably be necessary on account of the dampness of the atmosphere.

For new installations the authors recommend a voltage of 400 at motor terminals for a three-phase alternating-current system.

It is a common sight to see motors, which have been rated on the assumption that they would be used in a temperate climate, working continuously up to their full load as marked on the name plate, and even at overloads; this accounts to a great extent for the large amount of rewinding that has to be done. The temperature of the air should be taken as 95 deg. F. under cover, and the following temperature-rises should not be exceeded: Generators and motors after six hours' run at full load, 63 deg. F.; motors driving intermittent loads after one hour's run at full load, 70 deg. F.

The water-tube boiler is most suitable. The use of the marine type with steel casing would probably be an advantage, as neither material nor labour for brickwork is good. A type using one length of tube only is advisable.

Turbines are being used for plants of 500 KW. and over. Larger condensers will be required than in England as the temperature of the cooling water will be about 86 deg. F. to 90 deg. F. The most suitable high-pressure switchgear is the totally enclosed ironclad sliding-carriage type. It must be insect and lizard proof, all ventilating holes should be covered with fine gauge wire netting, and all instruments should be enclosed. For low and medium pressures the ordinary marble-panel central-station type is quite satisfactory.

For high pressures multicore paper-insulated lead-sheathed armoured cable should be used. For low and medium pressures rubber-insulated cables may be used.

In view of the difficulty of drying out transformer windings after they have been immersed in oil, moderate sizes should be shipped in oil from the factory. Air-cooled transformers are not desirable.

For transmission lines steel poles are advisable, wooden poles of the necessary length being expensive and hard to obtain. With steel poles an earth wire is essential.

At certain periods of the year thunderstorms are of frequent occurrence, and lightning is very severe in some localities. Protection for overhead lines can best be obtained by:—

1. The use of step-up and step-down transformers for all but very short lines and by heavily reinforcing the insulation of the transformer coils nearest to the line, in conjunction with arresters of the horn type with carbon resistance in series with the earthed horn, or with electrolytic arresters.
2. An earth wire above the power wires, earthed at frequent intervals.
3. Earthing the neutral point of the generator and step-down transformer on the low-tension side.

In no case within the authors' knowledge where step-up and step-down oil-cooled transformers have been used, has damage by lightning been experienced other than to the line; on the other hand, in those plants where air-cooled transformers have been used or the generators have been connected direct to the line, failures of transformers, switchboard instruments, and generators, have invariably occurred even where earth wires have been used.

For lighting circuits a voltage of 230 must not be exceeded, and this may best be obtained from a small transformer; if single-phase, the centre point of the winding should be earthed, if three-phase the neutral point. The voltage between any two wires should not exceed 230. There have been several fatalities due to shock on alternating-current lighting circuits where the potential to earth was 230 or over.

Mine distribution is invariably effected by overhead wires on hard wood pole lines, the minimum height being nominally 18 ft. Connections between lines and switchgear are made by rubber cables, bare wires not being allowed within 7 ft. of any building. Rubber insulation lasts about 18 months if exposed to the weather, but so far no satisfactory substitute has been found to replace it; probably three-core rubber-insulated armoured cable would last longer, as the rubber would be shielded from the direct rays of the sun.

The only type of mine switchgear that can be called safe is the totally enclosed interlocked ironclad type. No-voltage and overload releases should be fitted in all cases. All iron work and motor frames must be earthed, and usually this means an earth plate to every motor.

Motors wound for voltages above 500 are not necessary for the majority of mining work, and, except in large sizes, are undesirable.

Former-wound stator coils should be used in preference to hand-wound. With semi-closed slots it has been found that coils of the "cut and push through" type are the most satisfactory. The slot insulation of all former-wound coils should be of mica moulded on to the coil after winding, the coil being treated under vacuum with a suitable impregnating solution before being placed in position in the slot.

Trouble with hand-wound coils has been frequently experienced, more especially in high-voltage motors, due to the difficulty of packing the wires tightly inside the slot and excluding air.

Manufacturers also frequently wind the coils so that the end turns are adjacent and have to withstand the full voltage of the coil.

Where speed regulation is specified, brushes and slip-rings should be of liberal design, and the latter should be well spaced to prevent short-circuits in starting. The most satisfactory type of resistance is the cast-iron grid, trouble having been experienced with liquid resistahces.

The connections between switch-panel and starter and between rotor and resistances are best made by three-core armoured cable equipped with sealing boxes, but single-core rubber-insulated cable if properly protected is quite satisfactory for medium pressures.

Winches should be of the double-drum variety with motor, resistances, switches, and tramway-type controller mounted on a bedplate of structural steel, the whole arrangement being as portable as is consistent with strength. The best arrangement is to mount driving spur wheel and band brake between the drums; this, without unduly increasing the width of the winch, gives the drums a wider pitch. The pitch of the rails is usually from 4 ft. 6 in. to 6 ft. 6 in., and a drum pitch of 3 ft. 9 in. gives good results.

As a high-speed puddler runs at 120 R.P.M. it is usual to employ a single-reduction back-geared motor in conjunction with a belt drive, a flywheel being generally used to help the motor at the moment the karang is dumped. Gears should run in an oil bath, otherwise owing to the dust and grit which is always about they become intolerably noisy.

The centrifugal pump is invariably used, as the water pumped contains grit in all cases. Purchasers of pumps should obtain characteristic curves for each pump they purchase.

When the alluvial deposits have been turned over and over by processes of increasing efficiency until their valuable contents have been exhausted, a time will come when lode mining will receive more attention.

As lode mining is sure to be carried out by European companies in future, we may look forward to the time when there will be a fairly heavy demand for electrical power from this source.

The engineering problems in lode mining are practically similar to those encountered in gold mining.

Finally, the authors urge all mine managers to install proper recording instruments, and to keep accurate records of power costs as a matter of routine; by omitting to do so one of the advantages of the electric drive is thrown away.

NEW PATENTS APPLIED FOR, 1919.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS (successors to W. P. Thompson & Co., of London), Chartered Patent Agents, 285, High Holborn, London, W.C. 1.

32,040. "Methods of transmission with alternating-current systems." A. M. TAYLOR. December 22nd.
32,044. "Sparking plugs." C. E. PERKS. December 22nd.
32,060. "Telegraph and telephone insulators." E. D. M. SCRIVENOR and TAYLOR, TUNNICLIFF & Co. December 22nd.
32,064. "Electrical coal-cutting machines." HUNTER & JACK, W. A. JACK and F. A. SCOTT. December 22nd.
32,066. "Automatically-operated electric switches." P. S. BROOK and J. A. HIRST. December 22nd.
32,080. "Production of electric oscillations for radio telegraphy or telephony." F. S. CHAMBERS. December 22nd.
32,090. "Protective devices for electric circuits." BRITISH THOMSON-HOUSTON Co. (General Electric Co.) December 22nd.
32,109. "Sparking plugs." O. G. NEAT and W. S. SHEPHARD. December 22nd.
32,132. "Manufacture of plates or sheets by electro deposition." S. O. COWPER COLES. December 22nd.
32,136. "Ionic valves." G. HOLST and NAAMLOOZE VENNOOTSCHAP PHILIPS GLORILAMPENFABRIEKEN and E. OOSTERHUIS. (Holland, December 31st, 1918.) December 22nd.
32,138. "Controlling means for carburetters, magnetos, &c." O. H. DYKE and L. A. ROBERTS. December 22nd.
32,164. "Electrical heater for wells." D. DIVER. December 23rd.
32,194-5. "X-ray apparatus." BRITISH THOMSON-HOUSTON Co. (General Electric Co.) December 23rd.
32,197-9-10. "Electric lamps." W. R. BULLIMORE. December 23rd.
32,006-7. "Sparking plugs." C. M. HORN. December 23rd.
32,206. "Trip mechanism for electric-ignition devices for internal-combustion engines." A. J. ADAMS. December 23rd.
32,231. "Manufacture of dry batteries for pocket lamps, &c." M. ZEILER. December 23rd.
32,244. "Thermionic valves." H. ST. J. DE A. DONNISTHORPE. December 23rd.
32,280. "Incandescent lamps." W. E. JOHN. December 24th.
32,289. "Electric switches, &c." J. P. ANNACKER. December 24th.
32,295. "Thermionic amplifiers." H. L. CROWTHER and J. ROBINSON. December 24th.
32,311. "Electric vaporiser." G. ENGLAND. December 24th.
32,327. "Electrically-operated mechanism for driving clockwork trains, &c." F. HOLDEN. December 24th.
32,328. "Engine starters." V. BENDIX. December 24th. (U.S., December 19th, 1917.)
32,346. "Electric circuit controllers." F. BECHOFF. December 24th.
32,371-3. "Electric arc lamps." F. BOARDMAN, F. R. BOARDMAN and R. V. BOARDMAN. December 24th.
32,372. "Reflectors for electric, &c., lamps." F. BOARDMAN, F. R. BOARDMAN and R. V. BOARDMAN. December 24th.
32,374. "Shades, globes and reflectors for electric, &c., lamps." J. MASON. December 24th.
32,392. "Sparking plugs." E. F. BURRILL and S. F. GRUBB and T. E. NANKIVELL. December 24th.
32,393. "Reception of electro-radiant energy." F. A. KOLSTER. December 24th. (U.S., March 31st, 1916.)
32,404. "Portable electric lamps." A. COHEN, H. W. MILLER and F. ZSINKOVITS. December 24th.
32,405. "Telegraphic wireless systems." H. J. DRANE, B. FRANKLIN and A. T. M. JOHNSON. December 24th.
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32,413. "Aerial systems for wireless signalling." S. B. SMITH and G. M. WRIGHT. December 24th.
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32,425. "Housings of electrical switchgear." A. H. CURTIS and IGRANIC ELECTRIC Co. December 24th.
32,450. "Electric heaters." H. F. MACLAUGHLIN and SIMPLEX CONDUITS, LTD., and L. M. WATERHOUSE. December 29th.
32,451. "Electric switches, circuit breakers, &c." V. HOPE. December 29th.
32,452. "Electric switches." V. HOPE. December 29th.
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32,474. "Automatically-adjustable ignition for internal-combustion engines." HORSTMANN CARS, LTD., and S. A. HORSTMANN. December 29th.
32,491. "Electric liquid heater." A. E. KALLAGHAN, C. A. KALLAGHAN, T. KALLAGHAN, and J. A. SMITH. December 29th.
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32,517. "Duplex cable signalling." L. COHEN. December 29th.
32,533. "Commutators for Ford car engines." A. E. LAMKIN. December 29th.
32,532. "Means for producing electric power." M. HARRIS. December 29th.
32,533. "Communicators for Ford car engines." A. E. LAMKIN. December 29th.
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32,576. "Magnetos." AMERICAN BOSCH MAGNETO CORPORATION. December 29th. (U.S., February 20th.)
32,588. "Regulating mechanism for electrical insulators." SOC. ANON. DES ETABLISSEMENTS L. BLERIOT. December 29th. (France, December 28th, 1918.)
32,597. "Magnetos for multi-cylinder engines." AMERICAN BOSCH MAGNETO CORPORATION. December 29th. (U.S., March 27th.)
32,611. "Mounting blades on the electric, &c., fans." W. S. BULPITT. December 30th.
32,624. "Apparatus for electric welding." R. F. WOODBURN. December 30th.
32,654. "Sparking plugs." W. A. HARBER. December 30th.
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32,670. "Electro-mechanical devices for producing vibratory motion." H. J. HANKEE. December 30th.
32,675. "Means for attachment of electric wire to sparking plug." M. H. SWINNARD. December 30th.
32,682. "Electric torches." W. G. HUDGELL. December 30th.
32,687. "Permanent magnets." S. Z. DE FERRANTI. December 30th.
32,692. "Electric coils." M. B. O'LEARY. December 30th.
32,693. "Electrical toy motors." M. B. O'LEARY. December 30th.
32,700. "Manufacture of negative electrodes for galvanic elements." F. BOCKER and A. EICHHOFF. December 30th.
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32,703. "Magneto-electric machines." A. M. ALLEN and R. B. NORTH. December 30th.
32,706. "Apparatus for suspending electric heating appliances used in hair dressing." H. SPEETJENS. December 30th.
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32,713. "Rotors of electrical machines." MASCHINENFABRIK OERLIKON. December 30th. (Switzerland, January 30th.)
32,724. "Variable electrical resistances." A. BURSILL. December 30th.
32,729. "Electro-magnetic mechanism for operating relays." AUTOMATIC TELEPHONE MANUFACTURING Co. and A. E. HUDD. December 31st.
32,732. "Control of crane hook motions actuated by alternating-current electro motors." H. MORRIS, LTD., and W. N. WESTON. December 31st.
32,753. "Electric fans and the like." J. B. MALPASS (Pottle). December 31st.
32,763. "Electrodes for oxidising nitrogen." F. H. LORING. December 31st.

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The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

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3,604. ELECTRIC CABLES. C. J. Beaver and E. A. Claremont. March 12th, 1917. (135,874.)

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17,429. IGNITION APPARATUS FOR INTERNAL-COMBUSTION ENGINES. American Whaley Engine Co. November 2nd, 1917. (120,887.)

18,072. ELECTRO-MAGNETIC WAVE TRANSMITTING AND RECEIVING SYSTEMS. P. D. Eckersley. May 5th, 1919. (135,895.)

18,076. ELECTRO-MAGNETIC WAVE NAVIGATIONAL ARRANGEMENTS. J. E. Murray and J. Robinson. November 4th, 1918. (135,896.)

19,906. METHOD OF AND APPARATUS FOR THE CONTROL OF ELECTRIC SUPPLY PLANT. H. J. Read and W. J. Brandsom. December 2nd, 1918. (135,922.)

19,955. ELECTRICAL EQUIPMENT OF MOTOR VEHICLES. W. A. Cocking and W. E. Hean. December 3rd, 1918. (135,926.)

19,985. ELECTRIC VAPORISERS AND HEATERS. Electro Steam Radiator Co. November 30th, 1917. (121,285.)

20,004. WIRELESS RECEIVING GEAR. British Thomson-Houston Co. and R. C. Clinker. December 3rd, 1918. (135,932.)

20,178. ELECTRICALLY-PROPELLED TRUCKS, TRACTORS AND LIKE VEHICLES. P. A. H. Mossay. December 5th, 1918. (135,951.)

20,241. ASSEMBLING AND SUPPORTING TUBULAR POSTS FOR CARRYING ELECTRIC INSULATORS. L. Joubert. December 6th, 1918. (135,953.)

20,650. ELECTRIC HEATER FOR AUTOMOBILE RADIATORS AND WATER STORAGE TANKS. J. D. Browder. December 11th, 1918. (135,964.)

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139. ELECTRIC IGNITION SYSTEMS FOR INTERNAL-COMBUSTION ENGINES. Dayton Engineering Laboratories Co. January 2nd, 1918. (122,184.)

806. ELECTRICAL EARTHING DEVICES. R. S. Woods. January 11th, 1919. (136,002.)

1,266. COMBINED ELECTRIC SWITCHES AND PLUG CONNECTORS. M. J. Railing, J. H. Farthing and J. B. Levee. January 17th, 1919. (136,006.)

1,752. LAMP SHADE TILTING DEVICES. A. S. Cubitt. January 23rd, 1919. (136,012.)

2,145. VARIABLE RESISTANCES PARTICULARLY ADAPTED FOR USE IN ELECTRIC WELDING. Quasi-Arc Co. and A. P. Strohmenger. January 29th, 1919. (136,016.)

2,569. IGNITION OF INTERNAL-COMBUSTION ENGINES. C. H. T. Alston. February 1st, 1919. (136,022.)

3,024. STORAGE BATTERIES FOR ELECTRICITY. G. F. Cooke. February 7th, 1919. (136,026.)

3,555. ELECTRIC ARC FURNACES. W. E. Moore. February 13th, 1919. (136,034.)

7,498. RADIO-TELEGRAPHIC TRANSMISSION SYSTEMS. W. J. Mellersh-Jackson. (A. Taylor.) March 25th, 1919. (136,059.)

8,085. MACHINES FOR USE IN THE MANUFACTURE OF ELECTRIC INCANDESCENT LAMPS AND THE LIKE. British Thomson-Houston Co. (General Electric Co.) March 31st, 1919. (136,062.)

10,755. MANUFACTURE OF MANGANESE AND ITS ALLOYS IN THE ELECTRIC FURNACE. C. L. Lenoir. January 8th, 1914. (126,303.)